BRIEF SKETCH

OF THE

GUNPOWDER WORKS

IN THE

PRESIDENCY OF BENGAL.

BY

MAJOR-GENERAL F. W. STUBBS, R.A.

It is only of late years that we have begun to learn what gunpowder is, to measure its power and control its strength. Till rifled weapons came into use, if the compound, when new, was capable of sending a shot a few hundred yards with sufficient momentum, it was considered serviceable. Although the proportions of its ingredients, and the main principles of its manufacture, have varied but little, the progressive improvements in the machinery employed, in making and testing it, have been numerous and important.

When our trading propensities led us to set foot in Bengal, a country brimful of saltpetre, we found its inhabitants well versed in the art of making gunpowder, and, at first, were content with the native article. Subsequently, works were established at Bágh Bázar in Calcutta, then at "Perrins' Gardens," which some time previously had been a place of fashionable resort for the English community. Here the manufacture of gunpowder and fireworks was farmed out to natives under the supervision of an English Officer, and subject to proof by a Committee, consisting of the Major (*i.e.*, senior in command), the Engineer, the Storekeeper and the Gunner.[1]

After a while, as Calcutta increased in size, it was found advisable to remove the powder works from the dangerous proximity to the matting and thatch, of which Bengali huts have, from time immemorial, been made. The new spot fixed upon was at Mánikhâli, a village near

---

[1] L. C. D., 3rd March, 1758.

Akra, about six miles below Calcutta; a Mr. William Smith was in charge in the beginning of 1772, and he was succeeded, on the 1st of December, 1774, by Lieutenant Robert Stewart, of the Native Infantry, who was styled "Superintendent of the Powder Works."[1]

At this time the Superintendent used to receive the materials from the Military Storekeeper, and manufactured the powder on the part of Government; but a proposal by him to supply it by contract was made and accepted in December, 1775. From the correspondence we find that the cost of English powder imported in that year was set down at 80 rupees per barrel. The details of the accountant are worth giving:—

	£	s.	d.	R.	a.	p.
Original cost and charges in England of 100 Barrels...	551	2	0			
Equivalent then to Rupees				5290	8	9
Six months interest on the amount paid in England				92	8	0
Freight from England (4 tons 9 cwt.)				1132	0	0
Hire of a sloop from Kalpi to Fort William				216	0	0
Landing charges				22	0	0
Re-making half the quantity at half the original cost (said to be a most moderate computation, as the greatest part of the English powder required to be re-made)				1322	10	0
Total				8075	10	9

By the terms of his contract, Mr. Stewart was bound to furnish annually 150,000 lbs. of either fine or coarse powder; which quantity was to be doubled on completion of the new works then in course of erection, at the following rate per 100 lb. :—

	Rupees.
Powder, new made	30
Powder, re-made and re-compounded with saltpetre	15
Re-drying and dusting	5
Each teak wood barrel lined with tinfoil, as recommended by Dr. Franklin	13

The cost of materials at this time by the Board's rate book was, per *man* of 80 lbs., 7 rupees for saltpetre, 6 for sulphur, and 1 for charcoal.

The proof required from the powder was, with a charge of 3 ozs., to project a 60 lb. brass ball 175 yards, from an 8-inch eprouvette mortar.

The grinding of the materials and their subsequent incorporation was at first performed by a *denki*; a heavy pestle, at the end of an unequally poised beam, falling into a mortar, and worked by the foot at the long end of the lever, such as may be seen at the present day

[1] Proceedings of the Board of Ordnance, 23rd December, 1775.

in Bengal used for pounding grain. There were some of them still in the factory at Ishapore in 1814. Colonel Anderson states that he saw powder worked up in this way in Afghanistan. The *denki* was superseded by pilon mills worked by bullocks. Cylinder mills were introduced by Captain Stewart; in these, the grinding and incorporating processes were performed by circular millstones[1] working in a small circle, and driven by bullocks, probably in the same manner as mortar is still mixed in India.

The contract system does not seem to have lasted long. Captain Stewart resigned his post on the 1st of October, 1782, and was succeeded by Mr. Edward Hay, a civilian, who received the title of agent. The Commander-in-Chief, on the recommendation of Colonel George Deare, the Commandant of Artillery, was anxious to have secured the appointment for Captain Vere Warner Hussey, of the same Corps, who had lately returned, severely wounded, from service on the Madras coast. The first serious accident recorded in the works occurred on the 1st of May, 1783, by which three out of four granulating mills, and the only two serviceable presses were destroyed.

During Mr. Hay's agency, Mr. John Farquhar was appointed his assistant, and when Mr. Hay resigned on the 6th of June, 1787, succeeded him. Mr. Farquhar, in every way a remarkable character, was born at Aberdeen in 1750, and was educated at the Marischal College, for the medical profession. Coming out to India at the age of nineteen as a surgeon's mate on board one of the Company's vessels, he left the ship at Bombay, and entered the army. Having received, in a duel as it was supposed, a wound in the hip, he removed to Calcutta for medical advice, and there became a free merchant. The Governor, Mr. Hastings, appointed him assistant to Mr. Hay, owing to his knowledge of chemistry, unconscious of the trouble he was entailing upon his successors by the selection. Though well connected, Mr. Farquhar was nevertheless penurious to a degree not excelled by any miser of historic fame. It was said that being invited to dinner regularly at stated intervals by Mr. Hay, he not only made the best use of his opportunity at the meal, but contrived to exist for the intervening days upon the unconsumed portions, which he conveyed home from that gentleman's hospitable table in a wallet, careful even to secure in bottles the water in which the meat had been cooked. His speculative genius extended to every species of buying or selling, exchanging or converting, all kinds of material substances whereby money could be made. The site of his piggeries may still be pointed out within the factory walls at Ishapore, and the descendants of the animals are to be found in numbers in its vicinity.[2] He steadily pursued a system of obtaining, in advance, as much as he could, both

---

[1] Some of them, if not most, came from near Chunár. Some were of an indurated quartzite; others of sandstone, but the latter could hardly be used in powder houses. They may be seen now about the factory, converted to other uses. The largest I have met with were 6 feet in diameter, and 14½ inches in breadth.

[2] There was, in 1876, an old chaukidár (watchman) in the factory, who had been, when a child, vaccinated by Mr. Farquhar, who doubtless charged a fee for the operation.

of money and material, and accounting for as little of it as possible. It is ludicrous to read the strongly worded resolutions of the Military Board on the reports of the Military Auditor General about him. In 1789, he is "peremptorily ordered to deliver in, on or before the 1st of January, 1791, his accounts of all the works executed by him at Ishapore, and of the advances he had received." In 1793, the Adjutant-General recommends the appointment of an assistant so as "to render Government in a short time independent of an agent, who seems so little disposed to conform to regulations." Lieutenants F. Corfield, N.I., and J. Agg, Engineers, were successively appointed, but without the desired effect. Mr. Farquhar pleaded in turn, press of work, illness, his wound, an accident, or some equally valid excuse for delay, now and then furnishing statements, of which little could be made in the audit office; but he never failed to ask for a further advance. In 1802, the Military Auditor General reported that since 1799, he had repeatedly called on Mr. Farquhar to adjust his accounts, not only without effect, but that by uniformly obtaining a special order for everything supplied or advanced, he had evaded the possibility of their exacting the particulars of a balance of ₨464,570 7a. 3p. against him. But regardless of such fulminations, he held on the even tenor of his way, making his money first, and his powder afterwards; which latter, it is only just to say, was much better than might have been expected, until, in 1814, it suited him to resign his appointment and go home, with a "fortune" estimated at nearly £500,000.

Captain Stewart had recommended the establishment of additional powder works higher up the river, at Chunar or Monghyr, not only to meet the increased demand, but also as a measure of security in the event of hostile attack. The question was again revived later on. It was quite possible for French ships of war to penetrate the estuary of the Hughli, as far as Mánikháli. Three miles north of the station at Barrackpore, at a place called Bánki-Bazár, now called Nawábganj,[1] there was a factory formerly built by some Ostend merchants. Beside this factory ran a natural water course, carrying off the overflow of the inland marshes, on the north bank of which stood the village of Ishapore. About the commencement of the year 1788, this spot appears to have been first proposed by Mr. Farquhar, as an eligible site for a gunpowder factory. He conceived a plan for utilizing the water of the stream as a motive power, and submitted a minute and able report, describing the tide mills which he proposed should be erected here. The question was, in May, 1788, referred to a Committee composed of Colonel Thos. D. Pearse, Artillery, President; Lieut.-Col. T. Call, Major M. Wood, Lieutenants J. Humphreys and J. Agg, Engineers, Members. The ground was surveyed by Lieutenant Wilford. The Committee adopted Mr. Farquhar's views, and a sum of 23,230 rupees was granted on the 23rd of July, for the construction of a single tide mill, but it does not appear to have been erected, perhaps

---

[1] Both names were then in existence, but the latter has now extended itself over the whole of the space from the Fulta Magazine to the Park Gate.

owing to the great cost of a system of sluices and flood gates for the whole of the works. It was, however, determined to remove from the old position at Mánikháli to Ishapore, and Mr. Farquhar was entrusted with the task of erecting the necessary buildings. From the 1st of January, 1791, by which date all were to have been completed, and the accounts settled, he was to restrict himself entirely to the manufacture of gunpowder. A valuable and interesting report submitted by Mr. Farquhar in February, 1793, shows that he had mastered all the details of his work, and was also well acquainted with the methods of manufacture in European countries. But the ruling passion of his life neutralized all the benefits which the Government might have derived from his undoubted abilities.

When the powder works were removed to Ishapore, the Agent's salary was fixed at 500 rupees a month, in addition to which, he was allowed a commission of five rupees on each barrel of powder passed into the service.[1] This was altered in 1801, to a salary of 1500 rupees without any commission;[2] and when, in 1832, Major Powney was appointed Agent, this, which after 1814 had been a staff allowance in addition to regimental pay, was reduced to 1000 rupees,[3] at which figure it stood until 1874, when, under revised regulations for the manufacturing departments, the three senior Superintendents were allowed 750 rupees, and the two junior 600 rupees per month as Staff allowance.[4]

In the year 1800, the erection of a new set of powder works at Pápámau near Allahabad was commenced, and Brevet-Captain Joseph Taylor, of the Artillery, who had been Mr. Farquhar's Assistant since December, 1794, was appointed Agent, with a Staff salary of 1000 rupees per month. The first proof of the gunpowder made here took place in November, 1801, and was favourably reported upon. These works continued in operation until 1829, when, in the economical reduction of Lord William Bentinck's administration, they, as well as the Ishapore works, were stopped.[5] The Allahabad factory was never revived, and the machinery was either sold, or sent down to Ishapore.

The gunpowder manufactured at Allahabad does not appear to have been superior to that made at Ishapore, with the exception of some made experimentally by Captain S. Parlby, in 1824–5, which was dried by steam instead of the usual method, on drying terraces,[6] by the heat of the sun. Captains Taylor, Galloway and Parlby, who were in charge of the Allahabad works were able and scientific Officers, and produced excellent powder. The damp climate of Bengal is without doubt a safer one for the manufacture than the arid one of the Upper Provinces with its dust laden atmosphere. Many years afterwards, Colonel W.

---

[1] Secretary to Government in the Military Department, 23rd July, 1788, to Military Board.

[2] *Ibid*, 21st February, 1801, to Military Board.

[3] *Ibid*, 8th October, 1832, to Military Board.

[4] Government General Order, No. 342, 4th April, 1874.

[5] Secretary to Government in the Military Department, No. 141, 12th June, 1829.

[6] Anderson's sketch, pp. 263-269

Anderson, Agent at Ishapore, was called upon to report upon the advisability of removing the works to the Upper Provinces, and he very decidedly gives his opinion upon the superiority of Ishapore.[1] At the same time, for other reasons, he advocated the establishment of another factory in the Punjab, the climate of which is still hotter and drier than that of the Doab, and where the frequent dust storms would render the manufacture of gunpowder a service of considerable danger.

When the Ishapore Factory was being re-constructed, Captain Galloway's services were required, and Captain James F. Dundas officiated for him at Allahabad (1814–1819); but during that time the quality of the gunpowder had deteriorated so much, that an investigation into the causes was deemed necessary, and Captain C. Graham was placed in charge until the appointment of Captain A. Lindsay in 1820. The only serious accident in these works took place on the 6th of April, 1824, when two sifting houses, containing 300 barrels of gunpowder, were destroyed.

The names of the Officers in successive charge of both the Ishapore and Allahabad Factories are given at the end of this paper.

When Mr. Farquhar went home, Assistant Surgeon James Hare, M.D., was appointed agent at Ishapore, but being soon afterwards called upon to accompany the Earl of Moira, Governor-General, to the Upper Provinces, Mr. A. Haig, also of the medical service, who then held an appointment in the neighbouring station of Barrackpore, acted for him. Captain James Young, Agent for gun carriages at Cossipore, was directed to assist Mr. Haig in his duties at Ishapore.

The condition in which everything had been left at this time was lamentable. Mr. Farquhar reported, March 6th, 1814, that there were 80 pilon sheds ready, and 57 actually employed; but Dr. Hare reported, May 3rd, 1814, to the Board, that he had a large quantity of powder accumulated, and in course of manufacture, with no place to store it in, and "nothing but the grassy field to dry it upon,"[2] and that Mr. Farquhar had left behind him no instructions, nothing but "some loose papers, containing interesting, but erroneous reasonings, and visionary schemes from Madras." And, on June the 25th, he reported that the cylinder mills, the only part of the machinery in tolerable repair, were much worn, that the pilon mills were so patched as not to be safe, and that the whole of the works were in a wretched state of delapidation. This state of things at last forced the Government to become independent of, and to control, its agents by learning itself the mysteries of the art of making gunpowder.

The first thing, therefore, done, was to assemble a Committee of Survey, under Major T. Anburey of the Engineers, to report on the works and buildings; and, as the extent of repairs considered necessary amounted in most cases to re-building, it was considered advisable to postpone them until the return from Fort St. George, of Captain Galloway, the gunpowder agent at Allahabad, who had, while on leave

---

[1] Anderson's sketch, pp. 209–211.

[2] Mr. Farquhar used to dry his powder on tarpaulins laid out upon the ground in the sun.—*Oral testimony.*

to sea, been ordered there to acquaint himself with the improvements being made in the Madras factory by Captain T. Fraser. The latter Officer had been sent home to study the English methods of manufacture, and had brought out with him models, on a scale of half-an-inch to the foot, of the incorporating, corning, sifting and glazing apparatus, as well as a full-sized press. The Madras Government, and General Abercromby, the Commander-in-Chief of that Presidency, had taken up the matter seriously; but Captain Fraser had returned to England before the permanent works had been completed. However, Captain Galloway, in May 1816, laid the results of his observations before the Bengal Government, in a long and able report.

Before this report was submitted, Lord Moira had convened (G.O.C.C. Oct. 30, 1815) another Special Committee to examine the works at Ishapore, and the general state of the manufacture carried on. It was composed of Colonel T. Hardwicke, Artillery, as President; Lieut.-Colonel McGregor, H. M.'s 59th Regiment, Major T. Anburey, Engineers, Major C. J. Doyle, Military Secretary, and Captain C. Hay Campbell, Artillery, as Members. I have not come across the report of this Committee, but the details would probably not be of much interest. The final result, however, was the appointment in October, 1816, of Captain Duncan McLeod, an Engineer Officer, to the post of gunpowder agent at Ishapore. Captain Galloway had previously (G.G.O. Jan. 12, 1816) been ordered to take over charge of the works from Captain James Young. He was directed to remain, and be associated with Captain McLeod in the construction of the buildings, and setting up of the machinery, with a staff salary of 500 rupees per month, in addition to his allowance as agent at Allahabad. Captain McLeod joined his appointment in March, 1817. The work was to be thus divided between the two officers;[1] Captain Galloway was to construct, in communication with Lieut.-Colonel Sherwood, the Principal Commissary of Ordnance, the charcoal furnaces, and all the improved cylinder mills, and to erect the buildings for them. On Captain McLeod devolved the erection of all the other houses, and the machinery necessary for refining and carrying on the rest of the process of manufacture, storage of material, and accommodation of establishment. As far as can now be made out, the only buildings of Mr. Farquhar which survive these changes, are the agent's house, now the residence of the head overseer, with some of the adjoining store rooms,[2] one of his conical charcoal furnace, now used as a charcoal room, and the Military Board's house, formerly the residence of an assistant, Mr.

---

[1] Secretary to Government in the Military Department, 30th May, 1817, to Military Board.

[2] The roofs of some of these store rooms are a curiosity. They are formed of hollow cylindrical 4-inch tiles set in mortar; a mode of construction both light and economical, and, at the same time, quite waterproof; while their present condition is a good proof of its durability. And the atmosphere of the rooms is free from the intensely oppressive feeling which solid masonry roofs in India always give. Similar constructions in some ancient buildings in Palestine had been mentioned by M. Volney in his travels (*Voyage en Syrie, Vol. 2, p. 399*). They had been copied in Paris, and Colonel Kyd of the Bengal Engineers, was at this time following up the idea which Mr. Farquhar carried out.

Brice, which was purchased in 1809, after his death.[1] A new "Agency House," now the Superintendent's, was built by Captain McLeod, and completed in 1819.

For all the buildings now proposed, it was necessary to take up more land, and an arrangement was made with the proprietor, Bábu Gopimohan Deb, by which he surrendered ten bíghas[2] of land, receiving in part exchange, five bíghas north of the Khál, and two more on the southern side, formerly appropriated to the charcoal yard.[3]

In July, 1817, notice was received by Captain McLeod, of the receipt from England of new machinery to the value of Rs13,151 9a. 4p. It is curious to observe the tenacity with which the Military Board clung to the old system of pressing the composition in masses about a foot thick. Captain McLeod had strongly advocated the method of pressing it in cakes three quarters of an inch thick between copper plates. The Board objected to the cakes as being "all crust," which they imagined would deteriorate more rapidly, and to the plates as diminishing amount and uniformity of pressure, proposing leathers instead, which, it is needless to say, proved an utter failure. They finally gave in,[4] and Captain S. Parlby, the Superintendent of the Model and Tangent Scale Department at Dum Dum, was ordered to prepare a model of the press-box, as used at home. This was much the same as those still made, which turn over on hinges for the insertion of the plates between which the composition is put. Captain Parlby, in forwarding the model, furnished a memorandum for the agent's guidance, and suggested the application of hydrostatic power, by which he said the act of filling and pressing would not take more than ten minutes, while there would be greater certainty in regulating the amount of pressure.[5]

The completion of the cylinder machinery for incorporating was delayed by the difficulty of casting the cylinders. Lieut.-Colonel Sherwood reported, July 10th, 1816, that the largest furnace in the Arsenal foundry would only contain 4¼ tons of metal, while Captain Galloway required cylinders of 6¼ tons of gun metal. The cylinders at Madras had been cast there under the superintendence of a M. Menand, and Captain Galloway gladly accepted the offer of his services.[6] However, it was not until March, 1820, that the first cylinder mill was reported ready, and in the following August, the removal of the old mills was sanctioned. A detail of the establishment, now authorized, is appended to this paper.

The work for which Captain McLeod had been selected was now finished; but though Government, in issuing the order of August 26th,

---

[1] Secretary to Government in the Military Department, 19th Sept., 1809, to Mil. Aud. Gen.

[2] The Bígha in Bengal contained 1600 square yards, not much more than half the amount in the bigha of the Upper Provinces, which contained 3025.

[3] Secretary, Military Board, 24th November, 1817, to Captain McLeod.

[4] *Ibid*, 27th April, 1819, to Captain McLeod.

[5] Captain Parlby, 31st May, 1819, to Captain McLeod.

[6] Captain Galloway, 18th July, 1816, to Military Board.

1820, which debarred Engineer Officers in future from holding the office of gunpowder agent, may have considered it advisable, the act was an ungracious one at the very best, and the more so, because Captain McLeod had discharged all the duties of his position with ability. Its injustice was made evident by the appointment of his Assistant, Captain Galloway,[1] a Native Infantry Officer, to succeed him. The scientific knowledge of the latter, and his capacity for the special work, did not affect the principle involved. With this exception, the appointment, both at Ishapore and Allahabad, was henceforth held only by Artillery Officers.

Major Alexander Lindsay[2] succeeded Captain Galloway at Allahabad, and on his promotion in 1824, Captain S. Parlby took his place, which he held until the works there were stopped in 1829.

In January, 1831, Lieut.-Colonel Galloway (the manufacture at Ishapore also having been stopped) made over charge of the factory to Sub-Conductor A. Morton, who had been employed in it since November, 1824. Major R. Powney[3] received it from Mr. Morton in September, 1832, and the manufacture re-commenced. During the short time that this Officer held the appointment, the grounds were greatly improved, well laid out, and many rare and beautiful trees were planted. From what period they were designated "the Park" is not known; but, till the cyclone of 1864 devastated this part of Bengal, the Ishapore Park was noted as being one of the most picturesque spots in the province, rivalling even the well kept grounds of the Governor-General at Barrackpore. In the mill-yard itself, the large clumps of the bamboo form an admirable protection against the spread of a flash in case of an explosion. Major Powney was succeeded in 1835 by Major James Tennant,[4] who had been the Assistant-Adjutant-General of Artillery. He was an Officer of more than ordinary ability, and had seen much service. Major Thomas Timbrell,[5] who had served with distinction in the Burmese war, 1824–25, followed him in 1837, and Major William Anderson, C.B.,[6] who had commanded Sháh Shuja's Horse Artillery in Afghanistan, was appointed in December, 1842. To the latter Officer we are indebted for a sketch of the mode of manufacture carried on at Ishapore, with some valuable notes by Lieut.-Colonel Parlby, who edited the work.[7] In April, 1854, charge was taken by Lieut.-Colonel James Abbott, whose very distinguished services as a political Officer, first in Afghanistan, and subsequently in

---

[1] Major-General Sir A. Galloway, K.C.B., became a Director of the East India Company. He died in London, April 6th 1850.

[2] General Sir Alexander Lindsay, K.C.B., died at Perth, 20th January, 1872.

[3] Died at home, 23rd January, 1865.

[4] Sir James Tennant, K.C.B., died March 6th, 1854, at Mian Mir, in command of the Lahore Division.

[5] Major Timbrell, C.B., retired in 1843, and died March 5th, 1875, at Reading.

[6] Retired a Lieut.-Colonel in 1855, and died 22nd September, 1869, at Albury Hall in Hertfordshire.

[7] Sketch of the Mode of Manufacturing Gunpowder at the Ishapore Mills. By Colonel W. Anderson, C.B.—London, John Weale, 1862.

the Punjab, have not been forgotten by his brother Officers, as they have been by an ungrateful government. He was followed by Lieut.-Colonel Vincent Eyre,[1] another Officer of Afghan repute, who took charge in April, 1858. Up to this time no changes had taken place, either in the machinery or mode of manufacture. The tide mills of Mr. Farquhar had been stifled in their birth, and since then the patient bullock had supplied us with the means of conquering Hindustan. The machinery which Captains McLeod and Galloway had set up outlived their day, and the reign of the great Company, of which the latter became one of the Directors. But after that Lieut.-Colonel G. E. Voyle[2] had succeeded as agent, it became his task to superintend all the work of introducing steam machinery to supersede animal power. In this respect, Ishapore was many years behind the neighbouring factory at Cossipore for the manufacture of bronze ordnance. The place was closed in 1866, and was made over for this purpose to the Public Works Department. It was opened again for manufacture on the 19th of January, 1869. Colonel Voyle was relieved in November, 1872, by Lieut.-Colonel E. Tierney, and the term "Agent" was exchanged for the appellation of "Superintendent." In the year 1876, Lieut.-Colonel Tierney, being on leave home, the compiler of this sketch, who was officiating for him, had the opportunity of collecting a great part of the information required for it, from the factory records, and from those of the Military Board and Ordnance Offices in Calcutta.

Since that year, a pebble granulating house, traversed on all sides, has been erected between granulating house, No. 2, and the two magazines near it; and a fourth group of incorporating mills on the north bank of the Khál. A second house for both glazing and dusting has been sanctioned for some time,[3] and is, it is believed, being erected this year. Quarters for an additional millman complete the list of new buildings.[4] The communications between the different houses are carried on by tram lines, which are shown in the plan.

From the time that the machinery and buildings of the Gunpowder Works at Ishapore were first constructed upon a regular and systematic plan, to the present time, the changes that have taken place have been chiefly in the gradual perfection of the means whereby the acknowledged principles of the manufacture have been carried out; and, within the last few years, of testing the results of every method which science now places at our disposal. The delicate nature of the rifled pieces which have superseded smooth-bores, of the projectiles and their fuzes, and the enormous charges required for the giants of modern

---

[1] Major-General Sir Vincent Eyre, C.B., K.C.S.I., retired in 1863, and died 22nd September, 1881, at Aix-les-Bains.

[2] Retired in 1872, and died 2nd October, 1883, at Barnes, in Surrey.

[3] It was included in the Valuation Returns, dated 25th May, 1877, and the machinery has already been sent out for it.

[4] The information regarding these additional buildings has been kindly supplied by Maj.-General Tierney. The plan accompanying this sketch has been copied from one rather roughly made out by the compiler in 1876.

warfare, have compelled us not only to obviate the injurious effects of fouling, and of the gases generated, but to limit, by all possible means, the explosive violence of the powder, without reducing too far its energy.

Of the three substances which enter into the composition of gunpowder, two give us little trouble beyond the care of refining and purifying them; the third, charcoal, appears to affect the combination of all, in a way not yet wholly understood. The stalk of "*arhar*" or "*dhál*,"[1] a tall annual plant, gives a charcoal which appears greatly to influence the resolution of the powder into gases. It is the wood principally used in Bengal. Two other woods, the "*jainti*"[2] and the "*bákas*"[3] have been used, but the first is preferred. Notwithstanding that wood, which attains its perfect maturity in ten months, cannot, one would think, be compared in many ways with the older woods used in England;[4] the *arhar* charcoal is very good, and differs very slightly in its constituent elements from English alder or willow charcoal, as the following analysis shows[5]:—

	Carbon.	Hydrogen.	Ash.	Oxygen with a little Nitrogen.
Cylinder-made Arhar	85·4	3·04	1·63	9·93
Alder...	87·0	2·97	1·24	8·78
Willow	85·82	2·88	2·02	9·28

Indeed, as far as external tests go, but little fault can be found with charcoal made from arhar stalks; though, as Dr. Macnamara suggested, when forwarding the above analysis, the want of density in its molecular aggregation as compared with that of charcoal made from the older woods, might give rise to greater rapidity in its deflagration.

A more general question was the subject of investigation by a Committee on the practice range ground at Dum Dum, between August, 1872, and September, 1873, of which Colonel H. A. Smyth, R. A., was the President, in consequence of the bursting of two experimental bronze guns cast at Cossipore, under circumstances which led to the supposition that the Ishapore L.G. powder was so violent in its action as to be unsafe. The experiments made by this Committee form a very interesting record, but no account of them could be intelligibly given here, without entering into fuller detail than the limits of a single

---

1 Cytisus Cajan.

2 Æschynomene Sesban.

3 Justicia Gandarusa.

4 The Rhamnus Frangula, commonly called black dog-wood, is cut for burning at ten years old; alder and willow about the same age. There is much difficulty in burning arhar wood slowly (longer than six hours), as I found in making experimental R.F.G.[2] powder in 1876.

5 Chemical Examiner to Government. To Inspector General of Ordnance and Magazines, No. 59, dated Calcutta, 6th May, 1872.

paper would allow. It is sufficient to say that Lots 1 to 51 of Ishapore L.G. powder were pronounced unsafe[1] for cast-iron guns on account of the amount and irregularity of the pressures exhibited; although it appeared that these might be safely reduced within normal limits by the use of palliatives, such as an empty paper cylinder within the cartridge, or transverse paper[2] discs, acting mechanically to retard ignition. But it was felt that a powder which was not considered safe without such appliances, could not be recommended. At the same time, some of the Madras powder which was tried, showed as much irregularity, and even more violence;[3] one round of Madras pebble having displayed, as the Committee remarked, perhaps the greatest violence that has ever been recorded, viz., 95 tons on the A plug. This evidently pointed to other causes than the inflammability of arhar charcoal, which was not used in the Madras factory. The question remained undetermined, as the means at the disposal of the Committee did not cover it; but they were enabled to suggest some modifications in the manufacture of the L.G. powder, which might be found to lessen its explosive violence; they also recommended the following specification as a standard for the proof of powder for general use with all present service guns in the country, from the 9-pr. M.L.R. up to the 68-pr. S.B. gun:—

"Five rounds with the 8-inch, 9-ton proof gun; charge 16 lbs.: projectile cast-iron round shot, affording mean pressures not exceeding 22 tons on the A plug; 13 tons on the B and C plugs; individual cases of excess over these figures not to exceed 2 tons at any plug; with a mean muzzle velocity of 1575 ± 25 feet." Also,—

"Five rounds with the 9-pr.; charge $1\frac{3}{4}$ lbs.; projectile 9 lbs.; affording a mean muzzle velocity of 1365 ± 25 feet."

These few brief details will suffice to show the general reader that the manufacture of gunpowder, like all chemical processes of great delicacy, though it is, strictly speaking, more a mechanical than a chemical compound, requires close attention to the minutest details, under the ever varying circumstances of physical causes, and for the different purposes for which it is required; but of the many and various subjects which the Artillery Officer has to turn his attention

---

[1] Since then these lots have, I believe, been pronounced serviceable.

[2] Discs of a more rigid material did not answer. Report of "Special Committee on Explosive Violence of L.G. Powder." Calcutta, 1873, page 29.

[3] The following, taken from pp. 34 and 61 of the Report, shew the highest pressures displayed by Ishapore and Madras L. G. powders with the 8-inch 9-ton proof gun:—

	Density of powder.	Charge.	Projectile.	Observed velocity.	Pressures at A	Pressures at B	Pressures at C	
	lbs.	lbs.	lbs.					
Ishapore, Lot 27, Oct., 1871 ..	1·795	30	180	1333	45·8	20·9	31·6	Pistons of half area used for A and C plugs.
Madras, Lot 1, June, 1872 ...	1·819	30	180	1363	49·4	*	42·8	*Copper turned over.

to, none, except perhaps those which concern the well-being of his men, are of greater interest than this.

List of Officers who have successively held charge of the Powder Works at Calcutta, Mánikháli, and Ishapore :—

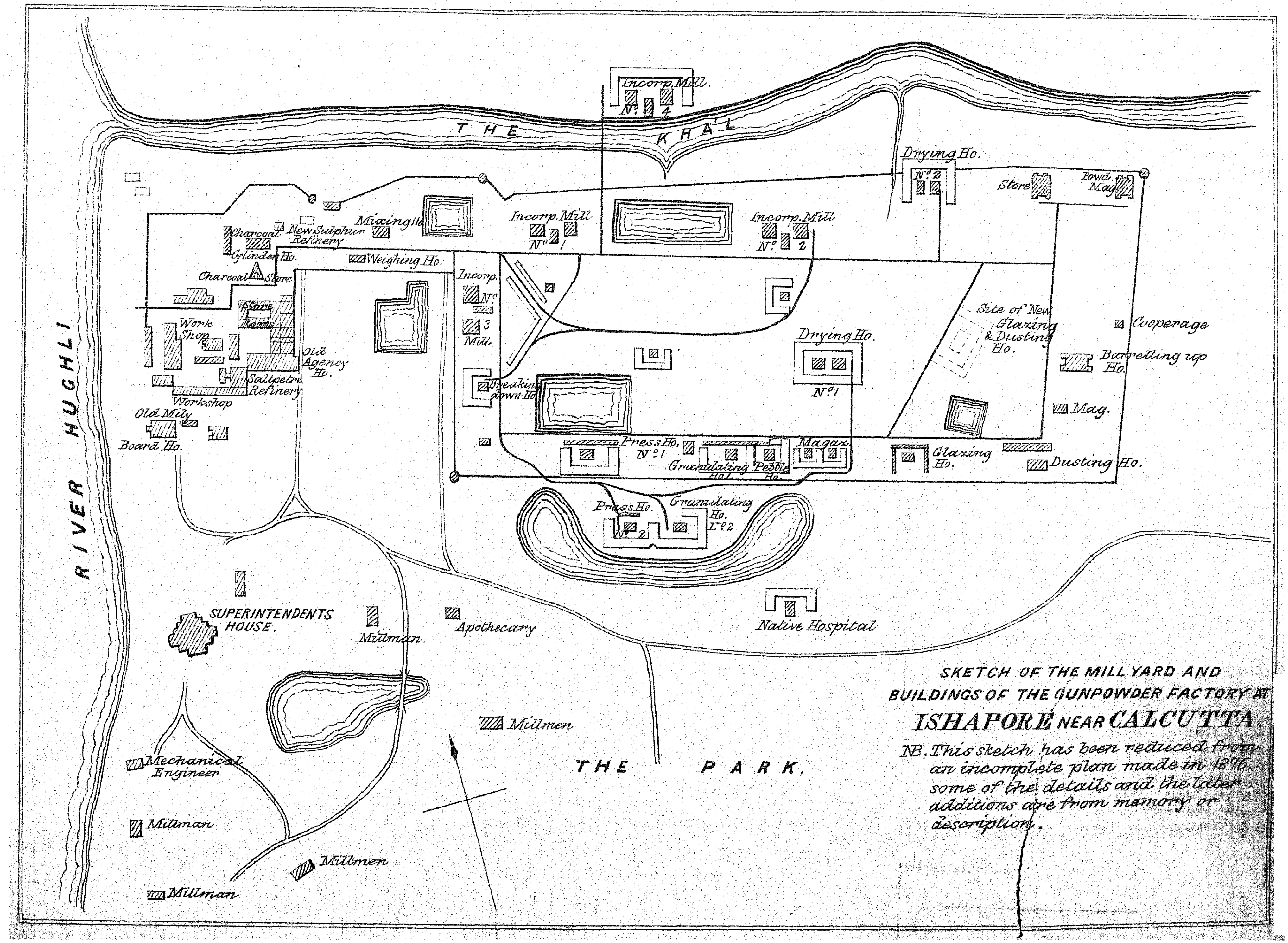
Captain Buchanan	Supervisor before 1876.
Major James Fitzpatrick	—
Mr. William Smith	Superintendent of Works before 1756.
Captain Robert Stewart	Appointed 1st December, 1774.
Mr. Edward Hay...	" Agent, 1st October, 1782.
Mr. John Farquhar	" " 6th June, 1787.
Assist.-Surgeon James Hare, M.D.	" " 1st March, 1814.
" A. Haig	Officiated during Dr. Hare's absence from July, 1814, to May, 1815.
Captain A. Galloway, 14th N. I....	Officiated, G.G.O., 12 January, 1816.
" D. McLeod, Engineers ...	G. G. O., October 11th, 1816.
" A. Galloway	Received charge, 1st November, 1820.
Sub-Conductor A. Morton	" about 13 January, 1831.
Major R. Powney...	" 1st September, 1832.
" J. Tennant	" 1st May, 1835.
" T. Timbrell	" 5th May, 1837.
Captain G. H. Swinley	Officiated, G.G.O., 16th December, 1842.
Major W. Anderson, C.B.	Appointed, G.G.O., 23rd December, 1842.
Major & Bt.-Lieut.-Col. J. Abbott	Received charge, 6th April, 1854.
Lieut.-Col. V. Eyre	" 2nd April, 1858.
" G. E. Voyle	" 17th May, 1862.
Major E. Tierney	" 25th November, 1872.
Colonel E. W. Childers	Transferred from Gunpowder Factory, Madras, by G.G.O., 8th January, 1881.
Captain C. H. Scott	Officiated for some time previously to being permanently appointed, 21st April, 1882.

List of Officers who successively held charge of the Powder Works at Allahabad :—

Capt. J. Taylor, Artillery	Appointed 8th May, 1800. Went home in 1808.
Capt. M. Stewart, H.M. 22nd Regt.	Officiated from 1808. Subsequently permanently appointed.
Capt. A. Galloway, 14th N.I. ...	Appointed 21st Jan., 1813. On leave to sea Nov. 1814. On his return did duty at Ishapore till permanently transferred in 1820.
Capt. James F. Dundas, Artillery...	Appointed to officiate, G.G.O., 14th Nov., 1814.
Capt. Charles Graham. Artillery ...	Appointed, G.G.O., 12th Oct., 1819.
Major Alexander Lindsay, Artillery	Appointed G.G.O. 25th Nov., 1820.
Capt. Samuel Parlby, Artillery ...	Appointed, G.G.O., 27th May, 1829.

Establishment authorized for the Gunpowder Agency at Ishapore by Government General Orders, 18th September, 1819 :—

		Monthly pay. Rupees.	
Preparation of Ingredients.			
1 Overseer ...		20	
For Saltpetre Refinery, Grinding House and Charcoal Yard ...	3 Sirdars at 10 ...	30	
	4 Mates „ 6 ...	24	
		—	74
Mixing and Incorporating.			
4 Overseers at 16 ...		64	
For Weighing and Mixing Houses ...	2 Sirdars at 10 ...	20	
	3 Mates „ 6 ...	18	
For Cylinder Mills ...	3 Sirdars „ 8 ...	24	
	6 Mates „ 6 ...	36	
		—	162
Finishing and Storing.			
1 Overseer ...		20	
For Pressing and Corning Houses ...	1 Sirdar at 10 ...	10	
	4 Mates „ 6 ...	24	
For Drying Yard, Sifting House, and Magazine ...	1 Sirdar „ 12 ...	12	
	3 Mates „ 6 ...	18	
		—	69
Artificers.			
Carpenter ...		16	
Cooper ...		12	
Blacksmith ...		14	
Coppersmith ...		12	
Painter ...		6	
Bricklayer ...		6	
Cooly ...		3	
		—	69
General Agency.			
Head Sirkar ...		50	
Accountant ...		50	
Writer ...		20	
Godown Sirkar ...		25	
Purchasing Sirkar ...		10	
Jemadar ...		7	
2 Lascars at 5 ...		10	
3 Ghariwálas (to strike the hours on a *ghari* or gong) at 4 ...		12	
6 Mális (gardeners) to keep the ground clean, at 3/8... ...		21	
1 Darwán (doorkeeper) for the Military Board's house ...		4	
1 Mánjhi (boatman) ...		4	
		—	213
	Total Sikka Rupees		602



SKETCH OF THE MILL YARD AND BUILDINGS OF THE GUNPOWDER FACTORY AT **ISHAPORE** NEAR **CALCUTTA**.

N.B. This sketch has been reduced from an incomplete plan made in 1876 some of the details and the later additions are from memory or description.

ABSTRACT OF THE PROCEEDINGS

OF THE

FORTY-SEVENTH ANNUAL GENERAL MEETING

OF THE

ROYAL ARTILLERY INSTITUTION.

THE 47th Annual General Meeting was held in the Theatre of the Institution on Thursday, 15th May, 1884, Maj.-Gen. H. A. Smyth, Commanding the Woolwich District, in the Chair.

I. The Notice convening the Meeting was taken as read.

II. The Abstract of the last Annual General Meeting was taken as read.

III. The Forty-seventh Annual Report, which was as follows, was read:—

1. The Committee beg to submit the 47th Annual Report of the Royal Artillery Institution.

2. There are now 1603 Members of the Institution, against 1583 last year. 80 Officers joined during the year, against 98 last year; while the deaths and withdrawals amounted to 48.—*See Appendix A.*

The number of deaths was 23, against 17 last year. Among them are to be noted those of two very distinguished Officers, General Sir E. Sabine, President of the Royal Society, and General Sir Fenwick Williams of Kars;—special obituary notices of whom have already appeared in the "Proceedings"; Majors-General P. Anstruther (late Madras Artillery), W. W. Barry, J. W. Domville, D. Paynter, and N. O. S. Turner; Colonel Sidney Parry; Majors F. B. Knox and J. R. Davies Cook; Captain W. R. M. Daunt; and Lieutenants H. J. Croft and J. S. C. Le Quesne.

11. The following Lectures were delivered during the year:—

Foreign Armour Experiments, and their bearing on our own Armaments. By Capt. C. Orde Browne, late R.A.

The Three Weeks' Campaign in Egypt. By Major G. B. N. Martin, R.H.A.

The Medical Department of an English Army Corps. By Surgeon-Major G. J. H. Evatt, M.D., A.M.D.

The Present State of Steel Manufacture, and its application to Military Matèriel. By Capt. G. Mackinlay, R.A.

12. The following changes in the Committee took place during the year:—

Lieut.-Col. R. Sandham.........	vice	Lieut.-Col. H. B. Maule.
Lieut. E. J. Granet	"	Lieut. R. A. Bannatine.
" P. H. Enthoven	"	" R. Tylden.
Major G. H. Marshall	"	Lieut.-Col. C. Thornhill.
Lieut. H. W. Morrieson.........	"	Lieut. E. J. Granet.
Major C. W. Long..............	"	Lieut.-Col. Hon. A. Stewart.

The Committee at present (1st April, 1884) is constituted as follows:—

PATRON AND PRESIDENT:

Field Marshal H.R.H. The Duke of Cambridge, K.G.

VICE-PRESIDENTS:

The Inspector-General of Artillery.
The Director of Artillery and Stores.
The Deputy-Adjutant-General, R.A.
The General Officer Commanding Woolwich District.

MEMBERS:

The Assistant-Adjutant-General, R.A.
The Director of Artillery Studies.
The Assistant-Adjutant-General, Woolwich.
The Secretary, Department of Director of Artillery and Stores.
General W. J. Smythe, F.R.S.
General Sir J. H. Lefroy, C.B., K.C.M.G., F.R.S.

Colonel E. Maitland.	Major G. H. Marshall.
Lieut.-Col. C. E. Nairne, C.B.	" S. C. Pratt.
" J. T. Leishman.	" J. M. Alves.
" W. H. Noble.	Capt. R. S. Watson.
Major E. H. Cameron.	" C. Russell.
" G. W. C. Rothe.	" J. R. J. Jocelyn.
" T. J. C. A. Studdy.	Lieut. H. W. Morrieson.
" C. W. Long.	" P. H. Enthoven.

Major H. W. L. Hime, *Secretary and Treasurer.*

Assistant Secretary.

Bankers:

Messrs. Cox & Co., and London & County Bank.

Solicitor:

E. W. Sampson, Esq., Woolwich.

TRUSTEES:

General Sir J. St. George, K.C.B.
" Sir E. C. Warde, K.C.B.
D.-A.-G., R.A., for the time being.

IV. The Annual Report having been read to the Meeting, it was proposed and carried:—

"That the Annual Report, as read, be adopted."

V. It was proposed and carried to request the Deputy-Adjutant-General, R.A., to obtain the sanction of H.R.H. Field Marshal the Duke of Cambridge, Colonel of the Regiment, that the following be the subject for the Prize Essay for 1885:—

"The Re-organisation of the Regiment as regards its Subdivision into separate branches of Horse, Field, and Garrison Artillery."

It was also proposed and carried that in case H.R.H.'s sanction cannot be obtained, the following be the subject of the Prize Essay for 1885 (with the usual limitations as to length):—

"How far is the question of massing guns in the field affected by modern improvements?"

VI. It was proposed by the Committee that the following changes take place in the Rules:—

RULE XIII.—To read as follows:—

"XIII. A special general meeting may be called by the Committee, a notice in writing specifying the objects for which the meeting is convened, signed by not less than five of its members, being suspended at the Institution for *seven* days before the day of meeting."

RULE XIX.—To read as follows:—

"XIX. The Institution will bear a share of the expense of a class at any *station*, at which as many as three of its members combine for the purpose; provided that the members in question do not receive pecuniary rewards from other sources. In that case it will be for the Committee to decide whether any assistance, and how much, be afforded."

RULE XX.—To read as follows:—

"XX. No alterations or additions to be made to these rules, unless a notice in writing, specifying the alteration or addition to be proposed, shall have been suspended at the Institution for *seven* days previous to the general meeting."

An amendment was proposed by Lieutenant Allsopp, R.H.A., and seconded by Captain Skinner, R.A.:—

"That the Rules stand as they are, and that under the circumstances alluded to in these Rules, notices, similar to those issued in Woolwich, be issued to all home stations."

This was put to the vote and carried by a majority; but it was ruled by the Chairman that the amendment was virtually "an addition to the Rules," and therefore could not be put without 14 days' notice.

The original proposition was not carried.

VII. Lieut.-Colonel C. E. Nairne, C.B., Major J. M. Alves, and Captain R. S. Watson, whose term of office on the Committee had expired, were re-elected.

(Signed) H. A. SMYTH,
Major-General,
Chairman.

15 May, 1884.

APPENDIX D.

Presentations to the Library.

Seventh Annual Report of H. M. Inspector of Explosives, for the Year 1882	The Right Hon. the Secretary of State for Home Department.
Report on the circumstances attending two explosions which occurred at the Factory of the Explosives Company (Limited), at Pembrey Burrows, Carmarthenshire, on the 11th and 17th November, 1882, respectively, by Col. V. D. Majendie, C.B.	
Report on the circumstances attending three explosions which occurred in Glasgow on the night of Saturday, 20th January, and the morning of Sunday, 21st January, 1883, by Col. V. D. Majendie, C.B.	
Report on the circumstances attending two explosions which occurred in London, on the night of the 15th March, 1883, at the Offices of the Local Government Board in Whitehall, and of the *Times* Newspaper, in Play House Yard, respectively, by Col. V. D. Majendie, C.B.	
Report on the circumstances attending an explosion of gunpowder and blasting cartridges, which occurred at the Factory of the New Sedgwick Gunpowder Company (Limited) at Sedgwick, near Kendal, on the 12th April, 1883, by Lieut.-Col. A. Ford, R.A.	
Report on the circumstances attending an explosion at the Bassinghyll Gunpowder Mills, June 15, 1883, by Capt. J. P. Cundill, R.A.	
Report on the circumstances attending an explosion which occurred at the James Watt Dock, Greenock, on the 16th August, 1883, by Col. A. Ford, R.A.	
Report on the circumstances attending an explosion of gunpowder, which occurred at the Gunpowder Factory of Messrs. John Hall & Son, at Furnace, Lochfyne, near Inveraray, on the 29th September, 1883, by Col. A. Ford, R.A.	

Report on the circumstances attending two explosions which occurred on the Underground Railway, London, on the 30th October, 1883, by Col. V. D. Majendie, C.B. and Captain J. P. Cundill, R.A. .... Report on the circumstances attending an explosion which occurred at the Chilworth Gunpowder Factory, on the 15th November, 1883, by Col. V. D. Majendie, C.B. .... Report on the circumstances attending an explosion of dynamite at the Town Hill Colliery, Dunfermline, on the 17th December, 1883, by Col. V. D. Majendie, C.B. .... Report on the circumstances attending an explosion at the Victoria Railway Station, Pimlico, on the 26th February, 1884, and the attempted explosions at the Charing Cross, Paddington, and Ludgate Hill Railway Stations, by Col. V. D. Majendie, C.B., and Col. A. Ford, R.A. .... Report on the circumstances attending an explosion which took place on board the Steamer "Aberdeen," off Gravesend, on the 1st March, 1884, by Major J. P. Cundill, R.A.	The Right Hon. the Secretary of State for Home Department.
Notes on the Government Surveys of the Principal Countries in the World .... Classified List and Alphabetical Index of Army Forms and Books .... Hostilities without Declaration of War from 1700 to 1870, by Lieut.-Col. J. F. Maurice, R.A. .... Report to accompany sketch Map of Routes between Suakim and Berber .... The Franco-German War, 1870–71, 2nd part, 18th section .... The Insurrection of the False Prophet .... Map of the Egyptian Sûdan—2 copies .... Précis on Annam and Tong-King .... Lithographs.—R. L., Nos. 141 to 150 .... R. C. D. Nos. 91, 143, 148[a], 149[a], 157 R. G. F., Nos. 68, 69, 70, 74, 78......... W. O. Photographs, Nos. 6077 to 6112, 6117 to 6121 and 6135 to 6235....................	The Right Hon. the Secretary of State for War.
Catalogue of the War Office Library, 1883 ... Accessions to " " No. 1, 1st January, 1884 .... Handbook for Military Artificers, 1883 .... " the 8-inch R.M.L. Howitzer of 70 cwt., on siege travelling carriage, L. S., Provisional, 1883, 2 copies.................... Handbook for the 6·6-inch R.M.L. Howitzer, on bed and ground platform, or on siege travelling carriage, L. S. Provisional, 1883. 2 copies	Director of Artillery.

Handbook for the 80-pr. R.M.L. converted gun of 5 tons on sliding carriage. L. S. 1883. 2 copies	Director of Artillery.
Handbook for the 10-inch R.M.L. gun of 18 tons on sliding carriage. L. S. 1883. 2 copies	
Handbook for the 13-pr. R.M.L. gun of 8 cwt. L. S. 1883. 2 copies	
Handbook for the 13-pr. R.M.L. gun of 8 cwt. L. S. 1884. 2 copies	
Handbook for the 64-pr. M.L. converted gun of 58 cwt. on Moncrieff carriage. L.S. 1883. 2 copies	
Handbook for the 12·5-inch R.M.L. gun of 38 tons on sliding carriage. L. S. 1883. 2 copies	
Handbook for the 7-inch R.M.L. guns of 6½ and 7 tons on sliding and Moncrieff carriage L. S. 1883. 2 copies	
Handbook for the 16-pr. R.M.L. gun of 12 cwt. L. S. 1883. 2 copies	
Index to "List of Changes in Military Stores," from January 1868 to December 1882. 2 copies	
Tables of Weights and Measurement of Royal Horse and Field Artillery Batteries........	
Range Tables for 5-inch B.L. gun, based on practice of 10. 7. 83., 23. 8. 83., and 4. 10. 83. 2 copies	
Range Tables for 6-inch B. L. gun, Mark III., based on practice, 3. 12. 83. and 29. 1. 84. 2 copies	
Range Tables for 12-inch R. M. L. gun of 35 tons	
Range Tables for 10-inch R. M. L. gun of 18 tons	
Manual of Mountain Artillery, 1882. 6 copies	D. A. General, R.A.
Extracts from the Proceedings of the Department of Director of Artillery, to date	
Memorandum showing the changes recently approved in regard to extension of service with the colours and enlistment in the Brigade of Guards	
Manual of Elementary Field Engineering, 1883.	
The Queen's Regulations and Orders for the Army, 1883	
Memorandum on the Persian Army, 1883	The Assist. Qr.-Mr.-General.
Map of Song-Kai-Delta (Tong-King) No. 311.	
French operations in Tong-King	
Précis of information concerning the Straits Settlements, and the Native States of the Malay Peninsula, with map. 1 Vol. (with errata and agenda), London, 1883	
Report of the Examination for Admission to the Staff College, held in June, 1883........	Dir.-Gen. of Military Education.

Examination for Admission to Advanced Class of Royal Artillery Officers, 1882. 3 copies Third Report on the Education of Officers, 1883 Report of the Final Examination at the Staff College, held in December, 1883	Dir.-Gen. of Military Education.
Journal of the Royal United Service Institution List of Members of the Royal United Service Institution, corrected to 15th April, 1883 ... Proceedings of the 52nd Anniversary Meeting of the Royal United Service Institution, held on Saturday, March 3rd, 1883	The Council.
Proceedings of the Scientific Meetings of the Zoological Society of London for the year 1883 .... A List of the Fellows, and Honorary, Foreign, and Corresponding Members and Medallists of the Zoological Society of London, corrected to 1st May, 1883 .... List of the Vertebrated Animals now or lately living in the Gardens of the Zoological Society of London. 8th edition, 1883	The Council.
Minutes of Proceedings of the Institution of Civil Engineers. Vols. 72, 73, and 74; Parts 2, 3, and 4 of 1882-3: with brief subject index .... Charter, Bye-Laws, and list of Members of the Institution of Civil Engineers................	The Council.
Professional papers of the Corps of Royal Engineers. Vol. 8............................ The Royal Engineers Journal (Monthly).........	The Council.
Transactions of the Literary and Historical Society of Quebec. Sessions of 1870-1 to 1882-3 .... Manuscript relating to the Early History of Canada. 1760	The Council.
Proceedings of the United States Naval Institute, Nos. 2-5, Vol. 9, and Nos. 1 and 2, Vol. 10, with Appendix	The Council.
Proceedings of the Institution of Mechanical Engineers, 1883, and No. 1, 1884...........	The Council.
Journal of the Military Service Institution of the United States, Nos. 14-16, Vol. 4, and No. 17, Vol. 5	The Council.
Journal of the Iron and Steel Institute, Nos. 1 and 2, 1883 .... Catalogue of the Library of the Iron and Steel Institute .... General Index to Proceedings for the years 1869-81	The Council.
The Archæological Journal, Nos. 158, 159, and 160, Vol. 40, 1883.......	The Council.
Journal of the East India Association, January, 1883	The Council.
Journal of the United Service Institution of India, Nos. 55-58	The Council.

Smithsonian Miscellaneous Collections, Vols. 22–27 ... Annual Report of the Board of Regents of the Smithsonian Institution for the year 1880 ...	The Council.
An Attempt to Test the Theories of Capillary Action, by Francis Bashforth, B.D., with an Explanation of the Method of Integration employed in constructing the Tables which give the Theoretical Forms of such Drops, by J. C. Adams, M.A., F.R.S. ...	The Authors.
Saturated Steam, the Motive Power in Volcanoes and Earthquakes, by R. A. Peacock, C.E., F.G.S. 1 Vol. 2nd Edition. London, 1882	The Author.
Seminvariants and Symmetric Functions, by Capt. P. A. MacMahon, R.A. ...	The Author.
Military Transport by Indian Railways, by David Ross, C.I.E., F.R.G.S. 1 Vol. Simla, 1883 ...	The Author.
The Nordenfelt Machine Guns, described in detail and compared with other systems, also their employment for Naval and Military purposes, by G. Nordenfelt. 1 Vol. Portsmouth, 1884 ...	The Author.
Notes on Stone Implements from South Africa, by Major H. W. Feilden, F.G.S. ...	The Author.
Military History Notes, by Major Sisson C. Pratt, R.A. ...	The Author.
Papers on Mechanical Subjects, Parts I. and II., by Sir J. Whitworth, Bart., F.R.S. ...	The Author.
Stable Management, and the Prevention of Disease among Horses in India, by J. J. Meyrick, C.B., F.R.C.V.S. ...	The Author.
A Primer for Field and Mountain Artillery, by Major P. W. O'Connor, R.M.A. ...	The Author.
Practical Astronomy and Geodesy, by Lieut.-Colonel J. R. Oliver, R.A. ...	The Author.
The Quarterly Journal of Veterinary Science in India and Army Animal Management. Edited by Charles Steel, F.R.C.V.S., I.V.S., assisted by Fred. Smith, V.S., and John Henry Steele, V.S. ...	The Editors.
Fors Clavigera Letters to the Workmen and Labourers of Great Britain:— Letter the 91st—Dust of Gold ... " 92nd—Ashestiel ... " 93rd—Invocation ... " 94th—Retrospect ... The Story of Ida ... The Art of England, Lectures I. and II. ...	J. Ruskin, LL.D.
Catalogue of 6415 Stars, for the Epoch 1870. Deduced from observations made at the Glasgow University Observatory during the years 1860 to 1881, by R. Grant, M.A., LL.D., F.R.S., F.R.A.S. 1 Vol. Glasgow, 1883 ...	The Director of the Glasgow University Observatory.

Ordnance Notes, Washington, U.S., to date ... Notes on the Construction of Ordnance .... Report of the Chief of Ordnance for the year 1882	Brigadier-Gen. S. V. Benêt, Chief of Ordnance, Washington, U.S.
Examination Papers, R.M. Academy, Woolwich, for July, 1883, and February, 1884	The Governor, R.M.A.
Map illustrating the Military operations in front of Atlanta, G.A. .... Three Turkish Commissions conferred upon the late General Sir W. F. Williams, Bart., G.C.B., R.A.	Colonel Sir F. W. de Winton, K.C.M.G., R.A.
Elements of Quarternions. 1 Vol. Boston, 1881 .... Grammar of the Icelandic Language, by H. Lund .... Inquiries into Human Faculty, and its Development, by Francis Galton, F.R.S. 1 vol. London, 1883	Major H. W. L. Hime, R.A.
MS. book showing distribution of Companies of the Royal Artillery from 1819 to 1827 ...	Major E. H. Cameron, R.A.
Memoirs of the Royal Astronomical Society, 1882-3	Lieut. T. Preston Battersby, R.A.
Report of the Chapter of the Order of St. John of Jerusalem, 1883 .... Collections of the New York Historical Society for the Year 1875	Lt.-Colonel F. Duncan, R.A.
Report of the Astronomer Royal to the Board of Visitors, Greenwich, June 2nd, 1883...... Result of the Magnetical and Meteorological Observations made at the Royal Observatory, Greenwich, 1881	The Astronomer Royal.
Official Register of the Officers and Cadets of the United States Military Academy, West Point, New York, U.S.	The Supt. U.S. Military Academy.
Annual Report, Department of Militia and Defence, December, 1883	The Inspector-Gen. of Artillery, Dominion of Canada.
Plates of the Netherlands Artillery Atlas, Nos. 51-55, and Nos. 139-144	Netherlands Legation.
Relazioni Arsenale Militare Marittimo di Spezia Giornale di Artiglieria e Genio	The Committee of Artillery and Engineers, Rome.
Revista Militär Española, to date	Spanish Government.
Russian Artillery Journal, to date	Russian Government
Revista Marittima, to date	Italian Government.
Ratnik, to date .... Relazioni Intorno	Servian Government.
Artilleri Tidskrift, to date	Swedish Government.
Direcçao Geral Da Artilheria, Nos. 5-7, 1882, 1-10, 1883, and 1-4, 1884 .... Ordenança Sobre os Exercicios E Evoluçoes dos Corpos de Infanteria .... Programma Para os Exercicsos da Escola Practica de Artilheria, 1883-4 .... Relatorio Dos Trabalhos da Commissao de Aperfeiçoamento da Arma de Artilheria, 1882-3	The Director-General of Artillery, Portugal.

Regulamento para o Serviço Das Bocas De Fogo De Campanha, A. E. 8c (M. P.) e A. E. 9c (M. K.), 1882	The Director-General of Artillery, Portugal.
Nomenclatura da Peça A. E. 15c (M. K.) E Do Seu Respectivo Material, 1879 and 1883 ...	
2a Classe, Arreios E Equipamentos	
3a Classe, Instrumentos De Verificaçao	
4a Classe, Armas Portateis, Cartuchame E Capsulas..	
5a Classe, Correame, Equipamento Individual E Metaes	
6a Classe, Instrumentos Bellicos E Muzicos, Equipamento Regimental, Taras...............	
7a Classe, Materias Primas Com Diversas Applicaçoes, &c., &c., &c.	
From "Coruña to the Crimea," by Colonel F. A. Whinyates, late R.H.A....................	The Author.

APPENDIX E.

Books, &c., Purchased.

Metallurgy: Copper, Lead, &c. By W. H. Greenwood, F.C.S.
A Text Book of Geology. By A. Geikie, LL.D., F.R.S.
A Digest of the Law of Evidence. By Sir James FitzJames Stephen, K.C.S.I.
The Army Act Alphabet. By Captain G. Will, R.A.
Clery's Minor Tactics. 6th Edition, 1883.
A Handy Text Book on Military Law. By Major F. Cochran.
Field Artillery: Its Equipment, Organisation, and Tactics. By Major S. C. Pratt, R.A.
Report by the Committee on Solar Physics.
General Annual Return of the British Army for the year 1882.
Treatise on Natural Philosophy. Vol. 1, Part 2, 1883.
Ordnance Map of London and Suburbs.
Table of Logarithms and Anti-Logarithms (4 Figures), 1 to 10,000, arranged by Major-General J. C. Hannyngton, F.S.S. 1 Vol. London, 1880.
The Ibis: a Quarterly Journal of Ornithology.
The Nautical Almanack for the year 1884.
Jahresberichte über die Veränderungen und Fortschritte im Militarwesen. Berlin, 1883.
L'Etat Militare des Principales Puissances Etrangères au Printemps de 1883.
Dizionario Tecnico e Nautico di Marina, Italiano, Tedesco, Francese ed Inglese.
De la Conduite de l'Artillerie dans les Manœuvres et au Combat. 1 Vol. Paris, 1883.
Vocablaire Militaire, Français, Allemand, Italian, and Espagnol.
La Japon Militaire. 1 Vol. Paris, 1883.
Kriegsgeschichtliche Einzelschriften. Parts 1-3.
Guerre Franco-Allemande. 1883.
Sur La Force des Matieres Explosives. Vols. 1 and 2.
Die Gebirgs artillerie in den Europäischen Armeen. 1 Vol. Wein, 1883.
Der Organismus der Infusionthière. 1883.

Carnet de Poche a L'usage des Officiers D'Artillerie. 1884.
Instructions and Rules for holding Summary Courts-Martial under the Army Act, 1881. Reprinted, 1882.
Technical Marine Dictionary, German, French, Italian, and English.
Hind's Trigonometry. 5th Edition.
Hints to Travellers, Scientific and General. 5th Edition, 1883.
Military Law, its Procedure and Practice. By Major S. C. Pratt, R.A.
Encyclopædia Britannica. 9th Edition. Vol. 16.
Report of the British Association for the Advancement of Science, 1871-1881.
Arundel Society. Chromo-Lithograph: St. Stephen Receiving Ordination and Distributing Alms.
Dress Regulations for the Army. 1883.
Gould's Birds of Asia. Part 35.
" New Guinea. Parts 14, 16.
Map of Madagascar.
" Cochin China.
" Burmah.
The Army and Navy Calendar. 1883-4.
The Thanatophidia of India. By J. Fayrer. 2nd Edition.
Chapters on the Modern Geometry of the Point, Line, and Circle. By the Rev. R. Townsend, M.A.
Euclid's Elements of Geometry. By R. Potts, M.A.
Elementary Geometry. By R. Potts, M.A.
The Modern Application of Electricity. By E. Hospitalier. 2nd Edition, 1883.
The Theory of Equations. By W. S. Burnside, M.A.
Turning and Mechanical Manipulation. By J. Holtzapffel. Vol. 4, 1881.
A Text Book of Field Geology. By W. H. Penning, F.G.S. 2nd Edition, 1879.
Gunnery Drill Book for the Royal Naval Reserve. 1852.
The Gunner, shewing the whole Practice of Artillery. 1 Vol. London, 1628.
Trumpet and Bugle Sounds for all Branches of the Army. 1 Vol. 1883.
Questions for Examination in Military Law, Tactics, &c. By Major D. J. Lynch.
Permanent System of Military Administration. By Major J. W. Buxton.
Biologia Centrali Americana—
Zoology. Parts 23-29.
Botany. Part 16-17.

APPENDIX F.

Presentations to the Museum.

Chinese Envelope, in which the Ultimatum received by Admiral Seymour, R.N., in 1857, was enclosed	Lt.-Col. H. W. Vyner.
A Set of Egyptian Horse Appointments	Lt.-Col. L. F. Perry, R.A.
A Valuable Collection of British Birds Eggs... 29 Birds Skins .... 3 Animal Skins............ 2 Swans Eggs	John Welby Haughton, Esq.
Zulu skull. Found on the Battle-Field of Ulundi, January, 1883, at the Restoration of Cetewayo............	Lieut. F. E. D. Acland, R.H.A.

An Afghan Dagger	Messrs. Davis & Co.
Gunner's Priming Horn Model of Bronze Gun	H. Thomson, Esq.
Iron Hoe of Native African Manufacture, from an old burial-ground near Karkloop, Natal.	Major H. W. Fielden, A. P. D.

APPENDIX G.

Papers published in the "Proceedings" during the Year.

The Duties of the Personnel of a Battery of Field Artillery in Action. The Silver Medal Prize Essay, 1883. By Lieut.-Col. W. Kemmis, R.A.

Moving and Disappearing Targets for Rifle Practice. By Major G. B. Macdonell, R.A.

Comparative Table of English and Foreign Guns. By Major S. C. Pratt, R.A.

Experiments with Small Shot. By Major W. McClintock, R.A., Assistant Supt. Royal Small Arms Factory, Enfield.

Problems in Gunnery. By Major W. McCintock, R.A., Assistant Supt. Royal Small Arms Factory, Enfield.

Changes in the Royal Artillery. A Chronological Summary of the History of the Regiment. By Capt. R. H. Murdoch, R.A., Assistant Supt. R.A. Records.

Memoir of General Sir E. Sabine, F.R.S., K.C.B.

Notes on the Visits to the Military Academy, West Point, United States, and to the Royal Military College of Canada. By Capt. G. Mackinlay, R.A.

Abstract of the Proceedings of the Forty-sixth Annual General Meeting of the Royal Artillery Institution.

Foreign Armour Experiments, and their bearing on our own Armaments, and the Bombardment of the Forts of Alexandria. A Lecture delivered at the R.A. Institution, 13th April, 1883, by Captain C. Orde Browne, *late* R.A.

Casual Notes on the German Infantry and Field Artillery. By Major A. T. Wodehouse, R.A.

Notes on Accounts. By Colonel W. Stirling, C.B., R.A.

Ammunition of the 1-inch Nordenfelt Machine Gun. By Captain W. P. Blandy, R.A.

Notes on the Ordnance exhibited in the Russian National Exhibition at Moscow, in 1882, with a brief description of some of the chief guns, &c. By Captain J. C. Dalton, R.A., D.-A.-A. and Q.-M.-G., Gibraltar.

The Transit of Venus in 1882. By Captain G. Mackinlay, R.A.

Rough Notes on Mountain Batteries in India. By Captain A. Keene, R.A.

Notes on Certain Rough Methods of Approximating to Latitude and Longitude Determination, without Instruments. By Lieut. T. P. Battersby, R.A., F.R.A.S.

Memoir of General Sir W. F. Williams, G.C.B. By Colonel C. C. Teesdale, V.C., C.B., A.-D.-C.

Notes on the Words Gun, Gyn, and Pellet. Communicated by the Secretary.

Gunner Robert Graham's Petition for his Discharge. Communicated by Lieut.-Colonel J. A. Tillard, D.-A.-A.-G., R.A.

Vent Obturators. By Major G. W. Hawkins, R.A.

Sketch of the River Tormes, near Salamanca, made in presence of the enemy by the late Maj.-Gen. P. Bainbrigge, for the Duke of Wellington, 24th June,

Note on Trajectories. By the Rev. F. Bashforth, B.D.
The Arming of the Personnel of Artillery. By Captain R. F. Johnson, R.A.
A Plan for Assisting the Memory in Retaining the Signs of the Morse Alphabet. By Major H. B. Laurence, Q.-M.-G.'s Department, Bombay. Communicated by the Secretary.
Manœuvres of the XI. German Army Corps. By Lieut. G. Osborn, R.A.
Notes on the Tactics of our Small Wars. By Lieut. C. E. Callwell, R.A.
Garrison Gun Drill. By Captain F. G. I. Lillingston, 2nd Brigade, Cinque Ports Division, R.A. Communicated by Colonel W. H. Goodenough, C.B., R.A.
Wild Fowl and Punt Guns. By Major W. McClintock, R.A., Assistant Superintendent, Royal Small Arms Factory, Enfield.
Laying Guns. By Major C. S. B. Parsons, R.A.

APPENDIX H.

Précis and Translations published during the year.

FRANCE...

"Revue d'Artillerie." October, 1882. By Captain J. W. T. Spencer, R.A., A.-D.-C.
Manœuvres and Practice of Batteries of Horse Artillery attached to Cavalry Divisions.

"La Guerre d'Orient en 1877–78." By Captain N. L. Walford, R.A.
Description of the Russian screwed-up 8-inch Gun of 5·5 tons.

"Revue d'Artillerie." June, 1883. By Capt. F. W. Campbell, R.A.
Trial of Repeating Weapons in the United States.

"Revue d'Artillerie." By Major T. H. Lloyd, R.A.
Tactical Studies for Officers of Garrison Artillery.

"Spectateur Militaire." October, 1883. By Captain H. H. Costobadie, R.A.
Miscellaneous Notes.

"L'Artillerie à Cheval et la Cavalerie." From the German of Major Schlieben, by Capitaine Bodenhorst. By Captain J. W. Spencer, R.A., A.-D.-C.

"Revue Militaire de L'Etranger." August, 1883. By Major J. H. G. Browne, R.A.
Tiers of Fire applied to Field Fortification.

"A Pamphlet." La France—Est-elle Prête. By Captain H. H. Costobadie, R.A.

GERMANY

"Organ," &c. Parts 3 and 4, Vol. XXVI. By Lieut. J. M. Grierson, R.A.
Changes in Various European Armies during 1882.
The Spade in Warfare.

"Neue Militärische Blätter." By Capt. H. H. Costobadie, R.A.
Instruction in the Art of Shooting.

"Militär Wochenblatt." October, 1883. By Lieut. W. A. Macbean, R.A.
The Re-organization of the Russian Cavalry.
River Crossing by the 4th Russian Cavalry Division.

ITALY......	"L'Italia Militare." April to August, 1883. By Lieut. G. E. Weigall, R.A. Recent Trials of Schneider and Compound Plates. Artillery Practice in Austria. The Armament of Ceuta. The Italian Mountain Artillery. Miscellaneous Notes.
RUSSIA ...	"The Russian Artillery Journal." Nos. 5, 6, 8 and 9, 1883. By Lieut. J. M. Grierson, R.A. The Mountain Artilleries of Europe. The French Artillery in 1882. Miscellaneous Notes. "Skobeleff's Campaign in Turkmenia, 1880-81." A Review. By Captain J. W. Murray, R.A.
AUSTRIA	"Organ," &c. By Lieut. J. M. Grierson, R.A. The Austrian Artillery in Bosnia, 1878. Miscellaneous Notes.
SPAIN......	"Memorial d'Artilleria." January and June, 1883. By Capt. J. C. Dalton, R.A. Horse Artillery; and the necessity for re-establishing it in Spain. Data concerning the Horse Artillery Guns of the Chief Foreign Powers.

REPORT

OF THE

OPERATIONS OF THE ROYAL ARTILLERY

IN THE

SOUDAN,

IN FEBRUARY AND MARCH, 1884:

BY

BREVET-LIEUT.-COLONEL F. T. LLOYD,

COMMANDING ROYAL ARTILLERY.

The following report is rendered as a simple record of the services of the Royal Artillery in the Eastern Soudan during the months of February and March, 1884, and not as an account of the campaign generally: any reference made to the action of the other Arms is intended to be only explanatory.

It has been the writer's aim to avoid all criticism on the operations, and to confine himself to describing, as briefly as possible, the part taken by the Royal Artillery in the campaign.

Preliminary arrangements.

ON the 13th February, 1884, orders were received by the Officer Commanding No. 6 Battery, 1st Brigade, Scottish Division, R.A., then quartered at the Citadel, Cairo, to prepare the Battery for service in the Soudan; and to take over two camel batteries from the Egyptian government.

The Battery was at once medically inspected, and marched at 2 p.m. on the 14th for Abbassiyeh, leaving behind sick and weakly men, prisoners, &c., to the number of 28. Camp was pitched in the desert some 300 yards south of the Main Barracks.

The marching out state showed—

3 Officers.
1 Battery Sergeant Major.
4 Sergeants.
7 Corporals and Bombardiers.
97 Gunners.
2 Trumpeters.

Total 114.

Names of Officers:
Major F. T. Lloyd.
Capt. C. W. Kellie.
Lieut. E. Foord.

The camp equipment, stores, &c., were carried by the battery transport, consisting of 10 mules and 6 carts, supplemented by 2 G.S. wagons horsed for the occasion by the Cameron Highlanders.

On the arrival of the Battery at Abbassiyeh it was joined by the following officers, who were attached for duty, viz.:—

Cairo General Orders, No. 15, of 15th February, 1884.

Lieut. (now Captain) Sir G. Thomas, G/B, R.H.A.
Lieut. C. H. S. Vores, I/2, R.A.
Captain J. H. Wodehouse, R.A. (Egyptian army).
Lieut. D. C. Carter, R.A. (Egyptian army).
Surgeon Lucas, A.M.D.
Veterinary Surgeon Beech, A.V.D. (Egyptian army), and 5 gunners and drivers (grooms and servants); the total strength then being,—

9 Officers.
116 N.-C. officers and men.

The tents selected were of three kinds:—

12 Mountain Battery tents.
10 Lascar tents.
10 Native Egyptian tents.

A site was selected for the camp, and the battery paraded to take over the equipment. Lieut.-Colonel Duncan, R.A., Commanding Artillery, Egyptian army, and the two Camel Batteries paraded under him, consisting of:—

Names of Officers: Lieut. Mukhtar Effendi. Lieut. Ali Bey.

2 Native Officers.
105 Native N.-C. officers and gunners.
80 Camels.
19 Horses.

Lieut.-Colonel Duncan then performed a few simple evolutions with the batteries, the words of command being given both in Arabic and in English.

The native N.-C. officers and gunners were, during the campaign, employed simply as camel leaders, and on fatigues and other duties not immediately connected with the service of the guns; the latter being carried out entirely by the English gunners.

The batteries were then marched off to camp, horse and camel lines laid down, and the camp completed.

Description of equipment.

The ordnance taken over consisted of 10 bronze rifled 84^{mm} guns of about 2 cwt., and sighted to 2000 mètres, mounted on wooden mountain carriages without limbers, and having a pair of shafts which could be attached rigidly to the point of the trail in such a manner that the guns could be easily drawn by hand—an arrangement both simple, durable, and effective.

The carriages themselves were somewhat old; and two of them afterwards gave way in action at the axletree: they were fitted with old pattern elevating screws.

The ammunition consisted of 2000 rounds of common shell and case shot, of which it was proposed that 1000 rounds—that is 100 rounds per gun—should be carried with the batteries in action, the remainder being kept in reserve at the base. This ammunition was packed for service in long wooden boxes, each containing 8 rounds of common shell and 1 round of case, and 9 cartridges. These boxes were about 3 ft. 6 ins. in length, 11 ins. deep, and 8 ins. wide, provided with lids sheathed with sheet iron, secured by a simple hasp, and having rings for attachment to the pack saddles of the camels, each camel carrying two boxes. The interior was divided into compartments. The shells were carried fuzed with a simple percussion fuze, easily set and apparently safe in transport.

The pack saddles were somewhat heavy, but were fairly well stuffed. The gun was carried in the usual cradle, and carriage and wheels on another.

The force above detailed was organized in two batteries of six and four guns respectively, which were placed under the command of Captains Kellie and Wodehouse, as follows:— Organization of Camel Batteries.

A Camel Battery. 6 guns.

Capt. C. W. Kellie.
Lieut. D. C. Carter.
„ E. Foord.

B Camel Battery. 4 guns.

Capt. J. H. Wodehouse.
Lieut. Sir G. Thomas.
„ C. S. Vores.

Friday, the 15th, was occupied in making final arrangements and having a marching order parade and drill.

On the 16th, transport carts were returned to store, and pack saddles drawn for the mules. At 2 p.m., the same day, began entraining at the Abbassiyeh siding, and completed about 7 p.m. Entraining. This was very tedious work with the camels, who were most unwilling to enter the trucks. A rope round their hind quarters was usually employed, manned by a dozen gunners; but even this failed sometimes. In the most perverse cases, one of the native sergeants made himself conspicuously useful by seizing the camel's lower lip with his teeth, and walking backwards into the truck with him. Each truck carried 4 mules; their hind quarters in each corner and heads in the centre of the truck. As each was put in its place, it was made to kneel, secured with a rope round the doubled leg, the rope being then passed over the neck and down and round the other leg. One camel broke its leg in entering the truck, jamming it between truck and platform, and had to be shot. Another broke loose soon after

starting, jumped from the train and was not re-captured in time to go on. Entraining the horses and mules was a more simple affair: after which the train left soon after 7 p.m. for Suez, taking up the ammunition, which was stacked near the Zapharan Palace, on its way.

Arrived at Suez Docks at 7 a.m. on the 17th, and detrained the whole within an hour. The s.s. transport "Rinaldo" arrived alongside the wharf at 3 p.m., and a beginning was made of the embarkation which, so far as the R. A. were concerned, was completed about noon the following day, when a large number of Commissariat camels, horses, and mules of R. E. and Military Police, as well as Commissariat and Medical stores were shipped, and the ship left the docks at 5.30 p.m.

Embarkation at Suez.

All the animals had to be slung on board, and were disposed on three decks; camels and mules in the hold; mules and horses on the main deck; and a few mules on the upper deck. There were no fittings of any sort for the animals or men; and as no kind of arrangements had been made for watering or feeding, some inconvenience was felt. The men lay on the upper deck, a few only remaining below to look after the animals.

They all bore the short voyage very well, except a few of the mules, and were eventually landed in good condition, though the heat of the 'tween decks was very great. The camels appeared to suffer the least.

The ammunition was stored on the main deck (no magazine having been provided) and covered with tarpaulins.

February 18th to 22nd. At sea.

Disembarkation at Trinkitat.

Arrived at Trinkitat harbour at 1.30 p.m. on the 22nd, and began unloading at once; but as the ship was moored some 300 yards from the beach, and only one horse boat was available, progress was somewhat slow. On more than one occasion the camels proved themselves excellent swimmers.

By the evening of the 23rd all the animals had been landed, and some stores, and the disembarkation completed the following day. The large horse boat was capable of holding from 16 to 18 camels, or from 20 to 22 horses or mules.

Camp was pitched near the east end of Baker's entrenchment, a line of nearly a mile in length, of irregular trace, coming down to the sea at either end.

Change of equipment.

Having some reasons for doubting the power and accuracy of the bronze guns obtained in Cairo, leave was obtained from General Graham to try to obtain some 7-prs. from the Navy, and by the ready kindness of Admiral Sir W. Hewett, one was obtained the same day from H.M.S. "Sphinx," and, subsequently, seven more. No field carriages, however, were to be had, and it was therefore necessary to fit the Egyptian carriages for them, as well as

could be done at such short notice; leather collars were prepared, fitting closely round the trunnions, and of sufficient thickness to make the latter fit the trunnion holes of the Egyptain carriages. A second narrow collar was added to prevent lateral motion of the gun in the carriage. This arrangement answered well for the time, but after each engagement it was found that the collars were much worn, and had to be renewed. On the return of the Batteries to Suakim after the battle of Tamai, brass collars were substituted.

In consequence of the difference of length between the bronze guns and the 7-prs., the elevating screws were useless and were removed, and elevation was given by means of two oak quoins, specially prepared; these, too, answered their purpose fairly well, though the lower quoin had some tendency to slip. Eventually, fresh holes were bored in the trails, and the elevating screws fitted for use with the 7-pr. guns.

On the 25th February the detail, as per margin, marched from camp to occupy Fort Baker, distant about 3 miles. The camels travelled well over the morass, which was only difficult in some few places, where the mud was from 12 to 18 inches deep, with a hard but slippery bottom. At this time it was passable with some difficulty for any Field Artillery. No camp equipment was taken, and the night was wet and stormy. The camels and natives returned in the evening, as the supply of water at the Fort was very limited. During the day continued sorting ammunition, and also on the following day. Also landed four 9^{cm} Krupp guns, with carriages and limbers, and about 1000 rounds of ammunition for them. The same day landed six 7-prs. of 200 lbs. from H.M.S. "Humber," and one more from H.M.S. "Sphinx," making a total of eight; also 7-pr. ammunition from H.M.S.'s "Hecla," "Sphinx," "Humber," and "Carysfort," amounting in all to about 580 rounds. On the following day converted the Egyptian boxes to take 7-pr. ammunition, by removing internal fittings, and packed the ammunition.

Lieut. E. Foord.
19 N.-C. officers and men.
19 Egyptians.
17 Camels.
2 bronze guns.

26th February.

Each box was packed with—

4 common shell.
3 shrapnel shell.
2 case shot.
9 cartridges.
1 box of R. L. percussion fuzes.
1 box of 5 secs. (or 15 secs.) M. L. wood time fuzes.

In a few of the boxes 3 double shells were substituted for 4 common shells, but none were ever fired. Each box was marked in chalk with the nature of its contents, and the whole divided equally among the subdivisions.

A Krupp gun was sent on to Fort Baker under Major Tucker, R.M.A., and placed in position there; it was dragged across the

Passage of the swamp at Trinkitat.

swamp without much difficulty by 100 men. This swamp dries up more or less as the season advances, but is affected by the strength and direction of the wind, which, when blowing from the north, seems to bring the water up higher. The R. E. had provided some stout woven mats for crossing the bad places, and a few of these were laid down and proved useful. Another Krupp gun was also placed in the S. W. salient of the entrenchment, commanding the approach from Fort Baker. When the force moved to the front on the 28th, this was manned by 9 men of the battery who were left behind, assisted by some Egyptian gunners. The whole force moved out during the afternoon of the 28th, independently; the camel batteries marching at 3.30 p.m. Lieut. Granet, R.H.A., having been attached to the R.A., on the 24th, by order of the Major General Commanding, was posted to B Battery, and Lieut. Sir G. Thomas was appointed Adjutant.

The camel batteries were now officered as follows :—

A Battery, { Captain Kellie.
Lieuts. Foord and Carter.

B Battery, { Captain Wodehouse.
Lieuts. Granet and Vores.

Lieut. Sir G. Thomas, *Adjutant.*

Bivouac of the force at Fort Baker.

There was little difficulty in passing the swamp, and the batteries reached Fort Baker about 5 p.m., and took up their assigned places in the square in the order of march for the following day. Fires were lit, and the men had their tea, and passed a fairly comfortable night, though some rain fell and the ground was rather swampy.

In order not to crowd the interior of the square, the G. O. C. gave orders that only 12 ammunition camels were to accompany the batteries, and that the men were to drag the guns. The rest of the camels were therefore picketed near the Fort, and also the mules, except those required by the Surgeon, Veterinary Surgeon, and to carry stretchers, camp kettles, &c. The men's kits and blankets were left at Fort Baker, and they marched only with their great coats rolled. Five gunners, time expired, volunteers from the troops on board H.M.S. "Jumna," joined on the evening of the 28th, and were attached to R.A. for duty.

1 N.-C. officer and 8 gunners were left at Fort Baker, in charge of the two bronze guns, the camels and stores.

Battle of El Teb.

The force left the bivouac at 8.30 a.m. on the 29th February, preserving the same formation as on the previous night, the guns in column of sub-divisions, in prolongation of the two side faces of the square, camels inside, and close to the guns. The ground was rather bad going at first, muddy and slippery with the recent rain, the soil being a light loam, sparsely dotted

with bushes, but the gunners made very light work of it. The day was cloudy but fine, and there was a pleasant breeze from the north.

After marching in a southerly direction about 3 miles, the position of the enemy could be clearly seen as the square approached it. At 10.30 the General ordered four guns to the front, and Lieuts. Granet and Carter were sent up with their divisions, and placed in rear of the front face, ready to move out when required. As the square continued to move on, guns could be distinctly seen on our left front, and two immediately in front, at a distance of about 1500 yards. The square then inclined to the right, apparently in order to enfilade the enemy's position, or to take it in reverse.

At 11.20 a hot fire was opened on the square both from the main position and from the battery on their left, but no reply was made on our side, the square merely inclining a little more to its right. The projectiles used by the enemy at this time were common shell with percussion fuzes, and shrapnel with time fuzes. The former were rather wild and fell mostly over, the latter were well timed, and burst in front of, and over the square, but usually too high. Commencement of the action.

At 11.40, the General ordered out four guns, which came into action where marked in the sketch, and opened fire first with common shell and percussion fuzes, and then with shrapnel and time fuzes. The range was found after one trial shot to be 850 yards, and the practice was excellent. The enemy stuck well to their guns for a time, but the fire of ours, assisted by the machine guns of the Naval Brigade was very accurate and well sustained. A few minutes later the other four guns were brought into action, two outside the left face, and two in the centre of the front face. Just previously to this, the square turned to its left, and advanced on the position. The guns were then all brought into the front line, and continued their fire whenever the square halted, engaging both the enemy's batteries, the more distant one at a range of 1500 to 1000 yards. On arriving at about 600 yards from the left battery, the enemy began to use case shot, for which the ground was very favourable, sloping as it did gently towards the square, the surface being hard and even.

Soon after 12 noon, the left battery was silenced, and that portion of the position was taken, the Krupp guns in it being turned on the main position by the Marine Artillery, and worked with good effect. Previous to this, however, the enemy had been coming down in great numbers on the square, sometimes in rushes of 20 or 30, more often in groups of from three or four to a dozen, and even singly. These would frequently advance within a few yards of our line before they were shot down, and in some cases even came to close quarters with our men. Round

after round of case was poured into them, but though they fell in great numbers, it seemed to have no effect in stemming their advance. On more than one occasion they got among the guns; one was knocked down with a rammer by Gunner Phipps, who was just in the act of loading; another was felled to the ground by Gunner Adan with his fist, in which he was holding a round of case, which he was about to put into his gun; a third was shot with a revolver by Bombardier Treadwell, when in the act of charging into the detachment. The gunners behaved splendidly and with great steadiness, serving their guns with much coolness and deliberation. This, in fact, was very necessary, for the supply of ammunition was but small, only 27 rounds a gun, and it was expedient to be careful of it.

Details of the fight.

Some 200 yards beyond the first Krupp battery stood a substantial building of one storey, built with sun-dried bricks, and 30 or 40 yards to the right of this, a large iron boiler lying on the ground. This house and boiler sheltered large numbers of the enemy, and on arriving within some 60 yards of them, the square paused for a few minutes. Our left guns shelled the house with common shell, and our right the boiler with common and shrapnel shell with terrible effect. A portion of the flanks of the square was now moved up to increase the length of the front line, so that the square became a long parallelogram.

At 1.15 p.m. the main battery was silenced, and the fire of our guns directed, partly on the masses of the enemy about the village, and partly upon the groups which still opposed our advance. A great number of dead lay behind and within the house and around the boiler, a large proportion of whom had been killed by Artillery fire. These two obstacles having been taken and passed, comparatively little resistance was made.

Advance on the main position.

The ground over which we advanced was thickly indented by rifle pits, capable of holding from two to a dozen men, some of them being as much as 15 feet in length. Each one was dug immediately behind a bush, so that it was impossible to ascertain where they were until they were actually reached. About 2.15 p.m., the wells were in our possession, the main position and village taken, and the enemy were in full retreat along the Tokar road.

Ordnance, &c., captured at El Teb.

Ordnance captured.

4 Krupp 9^{cm} guns with limbers.
3 bronze 84^{mm} rifled guns.
1 Gatling gun.
1 rocket tube.

Two of the Krupps and 1 bronze gun of the above were captured in the first battery.

Casualties.

Casualties.

Killed,—Gunner Angus.
Severely wounded,—Gunner McDonald.
Slightly wounded,—Captain Kellie. Vet. Surg. Beech.
Sergeant Jackson. Gunner Higginbotham.

Lieut. Sir G. Thomas had his horse shot under him. 1 horse and 2 camels were killed in addition to the above.

Ammunition expended.

Ammunition Expended.

Shrapnel shell	61
Common shell	31
Case shot	25
Total	117

The fire was exceedingly deliberate on account of the shortness of ammunition.

The R.A. bivouacked for the night at the main position, and a further supply of ammunition was sent for to Fort Baker. The effect of the 7-pr. guns in this engagement far exceeded my expectations; there was no hitch or delay in the service of them, the makeshift arrangements having stood well, the ammunition was good, the shell bursting well, and the fuzes all that could be desired.

Description of the position at the wells of El Teb.

The wells of El Teb are some eight or ten in number, and sunk along the line of the slight depression or "Khor" which intersects the main position; the water was fairly good, and the supply ample. That portion of the main position which lies to the eastward of the Khor, and which covered some three or four acres, was slightly entrenched; at the north end was a small work in which the guns were placed; it was revetted with sacks and barrels filled with sand, and with bushes. On every side except the south, rifle pits were dug behind nearly every bush, making the ground very dangerous for mounted troops. Apart from the position itself, the ground was perfectly practicable for wheeled Artillery, but, had any been present, although the enemy's loss would have been more severe, our own would probably have been at least no less than it was.

March on Tokar.

The following morning, March 1st, the force left El Teb for Tokar at 10 a.m. The men still dragged the guns, but as a number of small donkeys had been captured the day before, they were put in the shafts, and proved of great assistance. The day was very hot, with little or no wind, and the men suffered severely from want of water. The direct road to Tokar was left to the eastward, and a somewhat circuitous route adopted, latterly

through much high and dense bush. Some little difficulty was experienced in finding the exact situation of the place, but after an extended reconnaissance by the Cavalry, its direction was ascertained, and the town sighted at 3 p.m. A few shots were fired at the scouts, but no real resistance was made, and we arrived on the plain on which Tokar stands about 4 p.m. There

Description of Tokar.

are wells both within and without the town, with a fair supply of water, of which the troops stood much in need. The town itself stands on some 30 acres of ground, and was found to be strongly entrenched. A ditch, 7 feet deep, cut in the stiff loam, with perpendicular scarp and escarp ran all round it, except where some few buildings abutted on the plain, and it could have been held for any time against an enemy unprovided with Artillery. There was, however, no resistance, the inhabitants flocking out to meet us, exhibiting signs of joy, waving flags, firing muskets in the air, and kissing our hands.

The force bivouacked in a square formation, about 600 yards from the town. About 9 p.m. the ammunition camels, sent for from El Teb, arrived from Fort Baker in charge of Mukhtar Effendi.

Raid on the village of Debbeh.

The following morning Lieut. Granet was sent out with a strong escort to Debbeh, with camels, to bring in ammunition and guns which had been found there. A large quantity of the former was destroyed there, and 1500 Remington rifles. Lieut. Granet returned in the afternoon with 43 boxes of rifle ammunition, containing about 40,000 rounds, 1 bronze gun, and 1 Gatling. The ammunition was buried 2 feet deep outside the camp, and the spot carefully levelled. The next day (March 3rd) the Black Watch and Rifles marched for Fort Baker, and the remainder of

Return to Trinkitat.

the force with the R.A. the day after. Marching at 7.15 a.m., guns on camels, El Teb was reached at 11, when the R.A. halted for an hour and a quarter. Resuming their march at 12.15, and passing over the scene of Baker's battle of the 4th February, Fort Baker was reached at 2, and Trinkitat at 4 p.m., a march of about 16 miles.

Preparations for re-embarkation.

On the 6th, all stores and guns, except the 7-prs., were parked near the beach ready for embarkation, and were embarked next day, the Egyptian ordnance in the "Oakdale," and Egyptian ammunition, and all empty 7-pr. shell in a large dhow, camels and mules in the "Teddington." The work went on till 2 a.m. A large quantity of Egyptian ammunition was thrown into the sea by order of Major-General Buller, Commandant of the base, the boxes having been damaged. The embarkation of the animals continued on the following day, and on the 9th, the battery sailed in the "Teddington" for Suakim at 7 a.m., arriving there

Disembarkation at Suakim.

at 1 p.m. Began at once disembarking camels for the Commissariat as well as our own, and cleared the ship entirely by 4 p.m. on the 10th, and pitched camp on the east side of the harbour.

A thorough inspection of the camels was made the following day by Vet. Surg. Clayton, resulting in 10 out of the 78 being found unable to march from galls in front of the hips. A projecting bone of one of the last ribs appears to be the seat of these galls or humours, which are very large and deep. It would appear to be a most difficult matter to stuff the pack-saddles so as to prevent them.

Major Holley, Commanding M/1, 1st Brigade, R.A., reported himself as being encamped with his battery in the entrenchment on the south side of the town. He has furnished the following account of the manner in which his battery, which was landed from the "Jumna" when on passage home from India, was equipped, in order to take part in the further operations near Suakim:— M/1 R.A. joins the force.

Extracts from Journal of Major Holley, Commanding M/1, R.A.:—

. . . .

"The Battery embarked at Bombay for England in H. M. S. "'Jumna,' having been 14 years in India. 5th February, 1884.

. . . .

"14th February.—A vessel sent out from Aden intercepted us "with orders to go into Aden. We then received orders to take "tents and other stores on board, and proceed to Suakim. The "Battery being without equipment, except 24 carbines, I indented "for 48 more, thinking we should only have to garrison Suakim, "and as the battery was only 3 Officers, 84 N.-C. officers and "men strong, I thought this would be sufficient.

"15th February.—Left Aden.

"18th February.—Arrived at Suakim and disembarked on the "19th February. Pitched the tents we had brought from Aden "in the entrenchment on the south side of Suakim. Carbines "were issued; and in case of attack, we were told off to man a "portion of the works.

"21st February.—The enemy were seen in the distance, and "shots were fired.

"22nd February.—Major-General Sir G. Graham arrived at "Suakim: I saw Lieut.-Colonel Clery, his Assist.-Adjt.-General, "and requested him to let the Battery go to Trinkitat; but such "was not to be the case.

"23rd February.—The Admiral and the General left for "Trinkitat; and the 10th Hussars embarked that evening, and "I was left in command of about 200 British troops at Suakim.

"24th February.—As we expected to be attacked, Captain Ind "and 30 men of the battery were put into Baker's house at night,

"which was loop-holed and barricaded. The other portion of "the battery was to occupy Fort Euryalus with the Marines and "Blue Jackets; this arrangement continued until the 5th of "March, as the enemy were continually being seen, and we "expected to be attacked.

"27th February.—The black troops from Egypt became mu-"tinous, and the following day they were embarked and sent "back to Cairo.

"2nd March.—By request of Admiral Sir W. Hewett I took "over the transport duties with my battery: we had about 80 "mules and some very rough Egyptian harness to take over; "40 mules belonged to the regimental transport of the 75th "Regiment, and were very fine animals. They had been wrecked, "and could not be taken with the Regiment to Trinkitat, but "proved very useful to me. By aid of the sailmakers from "H. M.'s ships, the harness was made to fit the mules—in a way.

"6th March.—General Graham having returned from Trinkitat, "I met him at the Custom House at Suakim, and after some con-"versation requested permission to form a Field Battery: the "General told me to put on paper what I required. I did so at "once . . . .

"7th March.—I at once set to work to form a 4-gun 9-pr. "Field Battery. The 4 guns, 2 of 6 cwt., and 2 of 8 cwt. were "ready to land, on Naval carriages, in position on the entrench-"ments: they had been landed from H. M.'s ships. Captain "Hastings, R.N., kindly supplied me with ships' carpenters and "sailmakers; 9-pr. poles with chains were obtained from some "old Egyptian guns, and fitted to the four guns, a swingle-tree "was fitted on each side of the pole, as there were no splinter-"bars, teams of six mules were then hooked in. The limbers "only carried 24 rounds per gun, so pack mules were utilized to "carry ammunition: boxes containing 8 rounds were placed each "side of a mule, and thus 84 rounds per gun were carried, namely, "15 case, 48 shrapnel, and 21 common shell. This was all done "on the 7th, and I reported to the General that evening that the "battery was ready. He ordered me to parade for his inspection "at 10 a.m., on the morning of the 8th, and we marched past "him, and he complimented us on the serviceable turn out. I "should add that 15 horses were obtained, on which Officers, "N-C. officers and coverers were mounted.

"9th March.—I got rid of 31 mules as I had more than I "required.

"10th March.—Major F. T. Lloyd, arrived with his battery, "and became C. R. A. . . . ."

(Signed) E. H. HOLLEY,
Major, R.A.,
Commanding M/1 R.A.

On the 11th March, the following detail marched with the Black Watch, at 7 a.m., for Baker's Zeriba, distant about 10 miles south of Suakim:— March of a Division of the Camel Batteries with Advanced Guard.

Lieut. Granet, R.H.A.
22 N.-C. officers and men.
1 Native Officer (Ali Bey).
2 horses.
11 camels.
2 7-pr. guns with 100 rounds of ammunition.

The guns were placed in position at the two southern angles of the Zeriba. Lieut. F. C. Johnston joined the battery this day from England, and was appointed to take charge of the ammunition, and to superintend its supply to the guns when in action. Lieut. Johnston joins the Battery.

The remainder of the Artillery marched with the whole force at 6 p.m. The country, after the first two miles, was good going, the sand fairly hard, but much intersected by shallow water courses, and thickly covered with thorny bush and creepers of various kinds. The night was somewhat dark, and it was difficult to preserve a regular formation, but the Zeriba was safely reached soon after midnight, the position of it being indicated by a lamp on a high pole, visible for some miles. The force bivouacked outside and in rear of the Zeriba.[1] March of the force to the first Zeriba.

The following day (12th March) the force marched southward at 1.10 p.m., leaving for the protection of the Zeriba 2 Companies of the Black Watch, under Major Kidston, and 24 N.-C. officers and men with two 7-pr. guns under Lieut. Vores, R.A. Advance to the hills of Tamai.

The country became rather thicker with bush for a time, and a good deal of game was seen—quail, plover, sand-grouse, great bustard, hares, and a few antelope. As the hills were approached, the ground became more open. About 4 p.m., information was received that the enemy were in force in front, and the square inclined to its left. From a rocky hill to the right of our line of march, they could be plainly seen extending over a considerable front, and on the more distant hills they were in great numbers. The square soon resumed its original direction, and halted at 5 p.m., and formed a Zeriba on the reverse side of a slight rise in the ground. As the enemy showed in some force in front, the 9-pr. battery was ordered up and fired a few rounds of shrapnel, which appeared to disperse them. Form the second Zeriba.

About 12.30 a.m., that night the enemy fired a volley of musketry into the camp, and from that time until just on daybreak, a dropping fire was kept on the camp, which though ill-aimed and causing but few casualties, harassed the men, and The night before the battle of Tamai.

---

[1] A Zeriba is simply an enclosure made by cutting down the bushes of the thorny mimosa and sticking the ends in the ground, the bushy part towards the outside. When time allows a trench is dug outside all. It is very nearly impenetrable when well made.

prevented them from sleeping. The 9-pr. battery was placed in position in action in rear of the front face of the square, and the camel batteries, also in action, in rear of the right face. One camel was wounded in the night.

Battle of Tamai.
Formation of the force in two squares.

On the 13th March, the force was formed up outside the Zeriba at 8 a.m., in two squares: 1st Brigade, with camel batteries on the right, under Brigadier General Sir R. Buller; 2nd Brigade, with M/1, R.A. on the left, under Major-General Davis, in echelon from the left, and some 350 yards apart. The guns and carriages of the camel batteries were dragged by the men. The 2nd Brigade advanced about a quarter of an hour before the 1st Brigade, and had come in contact with the enemy almost before the 1st Brigade moved off.

Sketch A.

The positions of the two squares are shown in the sketch.

M/1 in action.

M/1, R.A., came into action on the right rear of the square, and opened fire with shrapnel, and eventually with case, in a direction nearly parallel with the line of advance of the 2nd Brigade. This battery remained in the open in action until ordered to join the 1st Brigade, materially checking the rush of the enemy on the right front corner of the square. The steadiness of this battery was remarkable, unsupported as it was by the Infantry, and its fire was of great service in preventing the enemy from working round to the rear face of the square.

Camel Batteries in action.

The camel batteries came into action with the 1st Brigade about 15 minutes after leaving camp, two 7-prs. at the left front angle, and four in the front face of the square. The fire of the former was mostly directed to their left and left front at the enemy, who were crowding up and over the great ravine, and attacking the 2nd Brigade, while that of the latter was to its front and right front at the enemy in and about the ravine, and on the further side of it. When it was evident that the 2nd Brigade had received a check and were retiring, the fire of the left guns was also more especially directed to the front of that Brigade, and was most effective against the enemy, who were rushing up a small branch ravine which divided the two squares.

The 1st Brigade hard pressed.

About 9.30, the enemy showing in great force on the right of the 1st Brigade: General Buller ordered a gun to that face. The enemy came on in great numbers, and, under cover of the bushes, penetrated within 15 or 20 yards of the square, charging with great fury and obstinacy. The case shot at that gun was soon exhausted, and several rounds of reversed shrapnel were fired from it at ranges of from 15 to 40 yards with exceedingly good effect, as was shown afterwards when the square moved to its right, and the number of the enemy killed by Artillery fire became apparent. The shrapnel practice was excellent, their fuzes bored to $\frac{1}{10}$th, the bursting shell appearing to sweep the enemy away

like flies. One round especially, from one of Lieut. Foord's guns, was a remarkable one, killing or disabling every one of a knot of about a dozen of the enemy who had gathered under the crest of the ravine, which the 2nd Brigade had again approached, and who, invisible to them from the nature of the ground, were preparing to make an upward rush. Three guns of the camel batteries were now pushed well forward on to a rocky spur from which they could see along a good part of the ravine, and remained in action until the cross-fire from the 2nd Brigade, which had then re-formed, compelled them to retire to the front face of the square.

It was about 9.45 a.m., when the General ordered M/1 to join the 1st Brigade, and that battery then opened fire, first from the left rear, and afterwards from the right rear of the 1st Brigade. **Sketch B.**

By 10.15, the action was virtually over, but fire was kept up at the retreating enemy with good effect.

Passage of the great ravine.

The whole force then moved to its right, skirting the ravine, which the 1st Brigade descended, and crossed with all the Artillery. This ravine was some 400 yards wide, with very precipitous rocky sides, the bottom was deep sand. Both batteries ascended the other side, and, passing across several smaller ravines with great difficulty over the broken ground, reached Osman Digna's camp, situate about ½ mile from the ravine. This was scattered over several small sandy depressions among the hills, and was quite invisible from the neighbouring heights. The water was soon found in the main ravine, abundant, and of fair quality. The whole force was watered, and returned to the Zeriba at 2.15 p.m.

Field State.

Field State, 13th March, 1884.

M/1, R.A.	6/1 Scottish Division, R.A.
3 Officers.	8 Officers.
66 N.-C. officers and men.	78 N.C. officers and men.
52 mules.	77 Egyptians.
15 horses.	56 camels.
4 guns.	9 mules.
	21 horses.
	6 guns.
	Lieut. Vores left at Zeriba with 22 N.-C. officers and men. 11 camels. 2 horses. 2 guns.

Casualties.

List of Casualties, 13th March.

M/1, R.A.—Killed, 1 horse. 5 mules.
6/1, Scot. Div. R.A.—Killed, 1 camel.
Wounded 1 Egyptian. 1 camel.

Expenditure of ammunition.

Ammunition expended.

M/1, R.A.—

Shrapnel shell	103
Common "	34
Case shot	45
Total	182

6/1 Scot. Div. R.A.—

Shrapnel shell	53
Common "	34
Case shot	45
Total	132

One 7-pr. gun carriage disabled from broken axletree.

Reconnaissance of the 14th March.

On the 14th the whole force again left the Zeriba at 8.30 a.m., and marched direct to the wells, distant about 2½ miles, to water the animals. The Cavalry then marched in the direction of the hills to reconnoitre; the 2nd Brigade, with the 9-pr. Battery, taking up a position on the north side of the ravine, over and commanding the wells. The 1st Brigade crossed the ravine to the south side, accompanied by the camel batteries. An excellent position, commanding an all-round fire, was selected for the latter, and the guns posted in action at the angles of a square formed by the Royal Irish Fusiliers, who acted as their escort.

Burning of Osman Digna's camp.

A desultory fire was kept up by the enemy upon the square, but no casualties occurred; very few of the enemy were visible, and the fire was not returned. Osman Digna's camp was then destroyed by burning, together with an immense quantity of ammunition. The force then returned to the Zeriba over the battle-field of the previous day. The men dined, and returned in the afternoon to Baker's Zeriba for the night: M/1 continuing its march into Suakim.

Return to Suakim.

On the 15th, the remainder of the force returned independently to Suakim, marching at 4.30 a.m. and reaching camp at 7.30 a.m.

Description of the country.

The country passed over in going to and returning from Tamai was fit for wheeled artillery, but it would have been impossible for any Horse or Field Artillery to have moved over the country on the south side of the ravine. The ground was very precipitous, and thickly strewn with large rocks and boulders. It was only with the greatest difficulty, and with much help from the gunners, that M/1 passed across the ravine and moved along the other side; the mules, however, were well driven by the mounted drivers; the pole-draught answered well, and the mules themselves were in good condition and proved very sure-footed.

The camels appeared to make easy work of it; but any long continuance of such ground must soon have resulted in sore feet.

From the 16th to the 20th of March the Royal Artillery remained in their respective camps. The metal collars, above spoken of, were fitted to the trunnions of the 7-pr. guns; the elevating screws re-fitted, ammunition re-sorted and re-distributed, and the batteries generally prepared again to take the field. Re-fitting.

On the 21st March, the detachment, as below, marched to Handouk with the Gordon Highlanders, where a zeriba was constructed. The wells of Handouk are some 10 miles from Suakim, and on the northern route to Berber :— Third Zeriba.

Lieut. D. C. Carter.
18 N.-C. officers and men.
14 natives.
11 camels.
2 horses.
2 7-pr. guns.

They remained there until the 25th, when they marched and joined the force at the 4th Zeriba for the advance to the wells of Tamanieb.

The same day General Graham inspected M/1, and expressed himself much pleased with the good service they had rendered. He afterwards inspected the defences of Suakim with the C. R. A.

On the 25th March the force once more left camp, at 2 p.m. (7-pr. guns on camels) and took a S.W. course towards the mountains, with the object of reaching Tamanieb. It was a very hot day, and the men fell out in great numbers, but only one gunner left the ranks. Arrived at the 4th Zeriba at 8 p.m., and advanced the following day over very rocky ground about 7 miles into the hills; but finding no water and very few of the enemy, returned in the afternoon into more open country, and formed the 5th Zeriba, bivouacking there at 4.30 p.m. Marched at day-break next day. The ground was very bad for the mules, some of it deep sand, and elsewhere ravines with boulders: the camels, however, went well. Eventually a ridge was reached when the ground was more even, and a few of the enemy appearing in sight, the 9-prs. fired a couple of rounds of shrapnel at them. Watkin's range-finder was tried but could not be used, as it was impossible to select any prominent object, the whole country being a chaotic mass of granite rocks intersected by ravines. The cavalry were compelled in many places to dismount and lead their horses, and it was only with the greatest difficulty that the 9-prs. could get along. Water was reached at Tamanieb at 11 a.m. fairly good and very plentiful. The village of Tamanieb was then fired, and the force returned to the 5th Zeriba at 3 p.m. after a very toilsome day, returning the following day to Suakim, 17 miles, without difficulty. Reconnaissance to Tamanieb. Burning of Tamanieb.

On the 29th March, M/1 returned guns and stores to the Navy, and embarked for England in H.M.S. "Jumna."

Next day, the whole of the Egyptian ammunition was handed over to Mr. Brewster, the Deputy Governor, and stored in the Egyptian stores.

Returning equipment and embarkation.

On the 1st April, the 7-pr. guns were returned to the Navy with their stores and ammunition, and the Egyptian guns, &c., handed over to Major Chermside, representing the Egyptian Government.

The camels and horses were then embarked on the "Teddington," and the remainder of the battery in the "Orontes."

Captain Wodehouse was left at Suakim with 40 Egyptian gunners.

H.M.S. "Orontes" and the "Teddington" sailed on the 3rd, the battery reaching Cairo on the 7th, and taking up their old quarters in the citadel.

June, 1884.

On the 29th March, M/1 returned guns and stores to the Navy, and embarked for England in H.M.S. "Jumna."

Next day, the whole of the Egyptian ammunition was handed over to Mr. Brewster, the Deputy Governor, and stored in the Egyptian stores.

Returning equipment and embarkation.

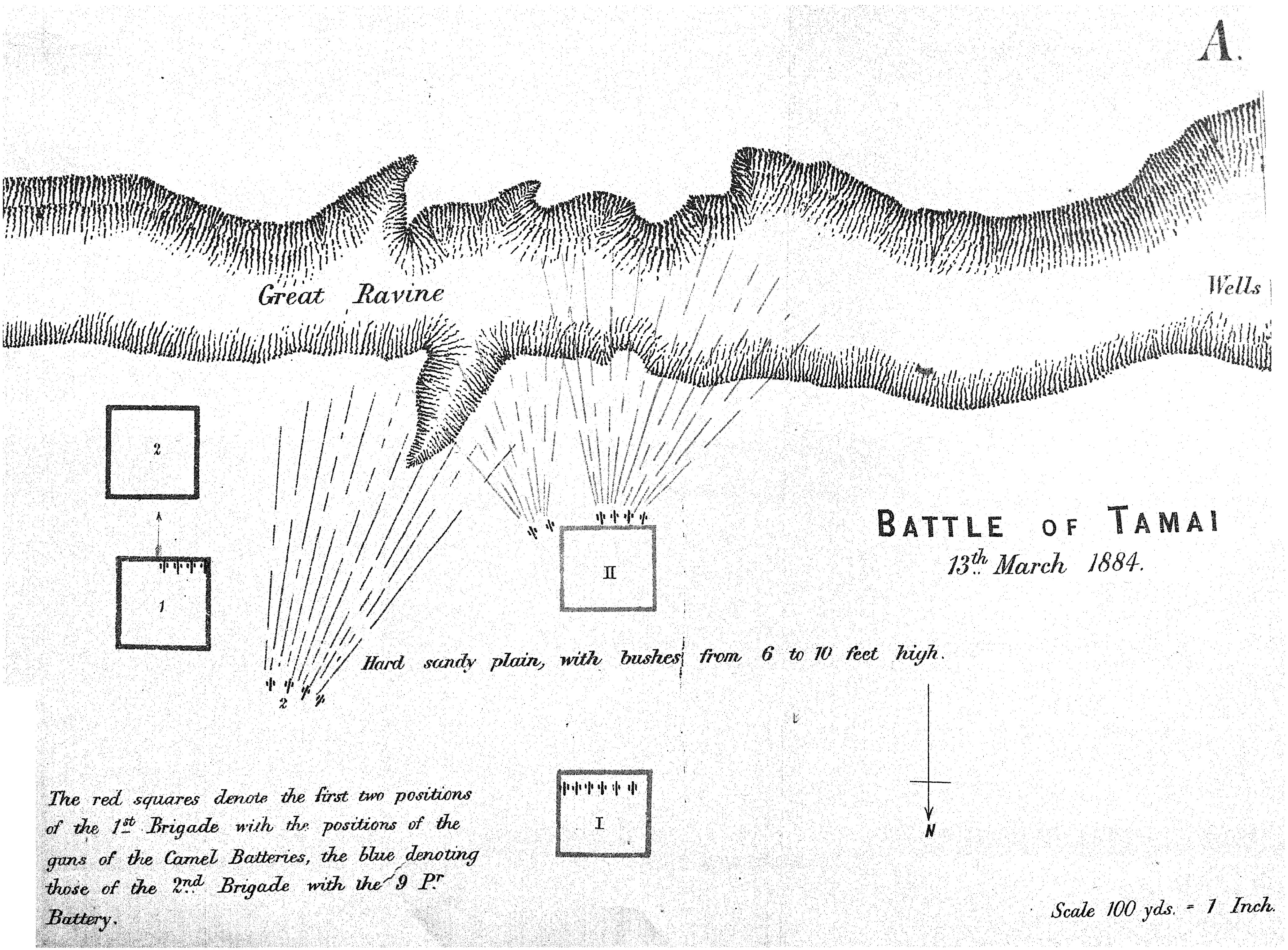
On the 1st April, the 7-pr. guns were returned to the Navy with their stores and ammunition, and the Egyptian guns, &c., handed over to Major Chermside, representing the Egyptian Government.

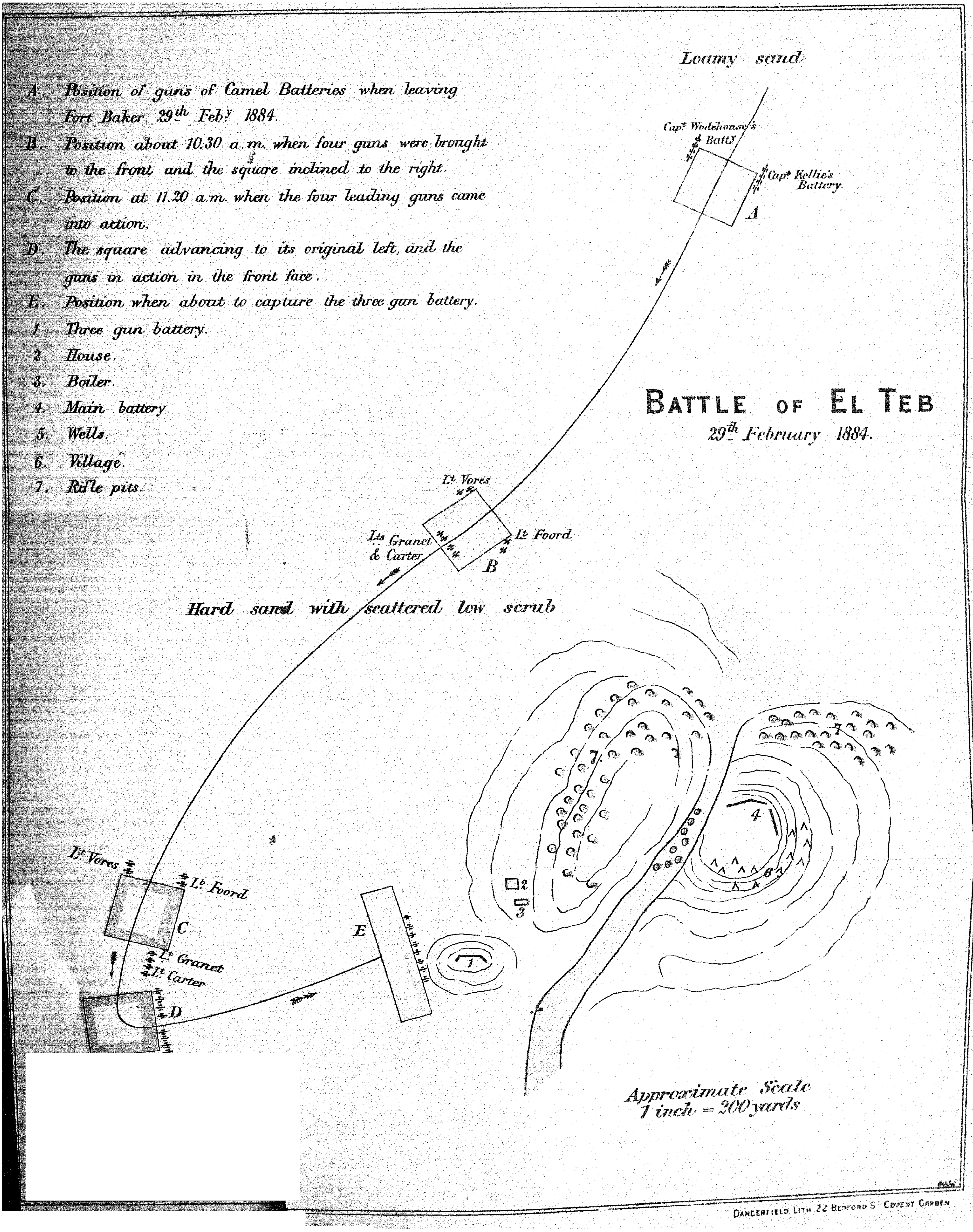
The camels and horses were then embarked on the "Teddington," and the remainder of the battery in the "Orontes."

Captain Wodehouse was left at Suakim with 40 Egyptian gunners.

H.M.S. "Orontes" and the "Teddington" sailed on the 3rd, the battery reaching Cairo on the 7th, and taking up their old quarters in the citadel.

June, 1884.


A.
Great Ravine
Wells
BATTLE OF TAMAI
13th March 1884.
2
1
II
I
2
Hard sandy plain, with bushes from 6 to 10 feet high.
N
The red squares denote the first two positions of the 1st Brigade with the positions of the guns of the Camel Batteries, the blue denoting those of the 2nd Brigade with the 9 Pr Battery.
Scale 100 yds. = 1 Inch.


BATTLE OF EL TEB
29th February 1884.
A. Position of guns of Camel Batteries when leaving Fort Baker 29th Feby 1884.
B. Position about 10.30 a.m. when four guns were brought to the front and the square inclined to the right.
C. Position at 11.20 a.m. when the four leading guns came into action.
D. The square advancing to its original left, and the guns in action in the front face.
E. Position when about to capture the three gun battery.
1 Three gun battery.
2 House.
3. Boiler.
4. Main battery
5. Wells.
6. Village.
7. Rifle pits.
Loamy sand
Capt Wodehouse's Batty
Capt Kellie's Battery.
Lt Vores
Lts Granet & Carter
Lt Foord
Hard sand with scattered low scrub
Lt Granet
Lt Carter
Approximate Scale 1 inch = 200 yards
Dangerfield Lith 22 Bedford St Covent Garden

FROM CORUÑA TO SEVASTOPOL.

THE HISTORY OF

C BATTERY, A BRIGADE, R.H.A.,

BY

COLONEL F. A. WHINYATES, LATE ROYAL HORSE ARTILLERY.

LONDON: ALLEN & Co., 1884.

A REVIEW:

BY

MAJOR H. W. L. HIME, R.A.

COLONEL WHINYATES has laid "C Troop" under a heavy obligation to him. He has furnished them with a history of their exploits which, we believe, is quite unique. Most of our own Batteries have, if not histories, at least records of their services; many Continental Artilleries possess similar records; but Colonel Whinyates' "History of C Troop" is so full, so painstaking, and so interesting, that we know of no other Battery-History that can in any way be compared with it.

In his introduction, Colonel Whinyates glances at the past history of Artillery, and explains how Horse Artillery first came into existence. He appears to have been led into an error, in connexion with Frederick the Great's Horse Artillery, by a statement made by the present writer in some papers on the "Mobility of Field Artillery," which appeared years ago in the "Proceedings." The statement in question is, that the Prussian Horse Artillery was destroyed successively at the battles of Kunersdorf and Maxen. Since the publication of the papers on "Mobility," a foreign officer has shown that this statement, made originally (it is believed) by a French writer, is absolutely without foundation.

After explaining the duties to be performed by the men of a Battery, including the immense labour that generally falls to the lot of the sometimes forgotten drivers, Colonel Whinyates makes a comparison between the old Trains of Artillery and the present highly-organised Batteries, which is both original and able.

The first formation of "C Troop" is given in Chapter II.; and the III[rd] Chapter contains a history of its first service in the field, the Coruña Campaign under Sir John Moore. We note with pleasure that Colonel Whinyates has not overlooked one of the most tragic events of that campaign:—the death of Mrs. Maloney, wife of the Master Tailor of the 52nd Regiment (p. 45).

In Chapter IV. Colonel Whinyates makes a digression into the history of "D Troop," one of the most distinguished of the many distinguished Troops of the Royal Horse Artillery; which was broken up in 1816, *because* it was commanded by the disobedient Captain Mercer (p. 68). No one will grudge the space devoted to C Troop's twin sister. Any separate account of "D Troop's," services is now more than improbable. Those who served in it are long since dead; and several important documents relating to it, which were intended to have appeared in the "Records of the Horse Brigade," by the late General Michell, have been lost through the negligence of a civilian printer. Even were this not the case, one single fact in its history was enough to justify Colonel Whinyates:—the message sent by the French General of Cavalry, Lallemand, the day after the combat of Ribrera to Colonel Whinyates' uncle, the late Sir Edward Whinyates, then 2nd Captain of "D Troop." "Tell that brave man," said Lallemand to an English officer who went to him on some business under a flag of truce, "tell him that if it had not been for him I should have beaten your Cavalry; but that, meeting me in every movement with his fire, he never would allow me to form for attack. Say that I shall mention his name in my orders as having been the cause of our defeat, and not your Cavalry. Be sure you tell him this. Promise me to give him my message" (p. 64).

When "C Troop" left Coruña Harbour on the 17th January, 1809, they left Spain for good. They took no part in the rest of the Peninsular War, nor were they employed at Waterloo.

To counterbalance this ill-fortune, "C Troop" was through the whole of the Crimean War, and played a distinguished part in it, including the memorable 25th October, 1854. The real history of the Light Cavalry charge, as both Mr. Kinglake and Colonel Whinyates admit, is yet to be written; for the *whole* facts of the case are not yet known, if they will ever be known. However, Colonel Whinyates' "*mémoires pour servir &c.*," in connexion with the services of "C Troop," are most valuable and interesting. He does not scruple to join issue with Mr. Kinglake when needful, and his criticisms upon some of Lord George Paget's observations upon Lord Cardigan's conduct are acute and to the point. It was in many ways most unfortunate that Lord G. Paget's observations were not published during Lord Cardigan's lifetime. Colonel Whinyates, however, proves himself to be a useful and powerful ally.

There is a strong comic element in Colonel Whinyates' account of the terrific storm that broke over the camp on the 11th November. Indeed many of his anecdotes are highly diverting. On that terrible day, "forage caps, cocked hats, cork mattresses, air pillows, &c., were blown away through the air like feathers . . . . It was impossible

to stand or walk upright, and the men had to go about on their hands and knees." A whole squadron of the Greys' horses had broken loose, and were flying before the wind, picket ropes, pegs and all, towards Sevastopol. In the midst of this hurly-burly, only two living things seemed in their element:—the pair of mules that drew Lord Lucan's cooking-cart. In the very height and fury of the storm, these worthy animals, "according to custom, gave themselves up to plunder . . . When loose at night, as they usually were, they would silently poke their heads, ears and all, into any tent not properly secured, and make free with the mens' biscuit, or anything else that came in their way" (p. 211.) But Tragedy and Comedy are closely allied. It would be difficult to describe the sufferings of all ranks during the dreadful winter of 1854–5: the sufferings of the drivers, in particular, are almost indescribable. Yet "hungry, and in mud and misery, they toiled on, turning out in the morning often without breaking their fast, and not returning till after dark, when, having taken, standing round the camp kettle, whatever food was ready for them, they set to work to groom their horses, frequently till late hours of the night" (p. 217). They "used to turn out with pieces of sack tied round their calves and loins for warmth . . . No boots of any sort had yet arrived, and the supply the men took from England was quite used up, the soles having been dragged off by the mud" (p. 214). "They could be seen trying to coax, as it were, their done-up horses to eat, holding the feed for them, rubbing their ears, &c., and staying by them until they themselves went to lie down in mud in a tent frowsy within, probably unwholesome from sick comrades unable to move, and covered in ice and snow without; not having any chance of removing their clothes, or opportunity of washing themselves; tormented with dysentry and diarrhœa during the hours of the night, and rising with aching bones in the darkness to begin their toil again. And so it went on from day to day, some of the weaker ones having to give in, but the majority holding on like brave men" (pp. 217–18). Well, indeed, may Colonel Whinyates say, "they deserve to have their names handed down," as an example to others. There was more than the spirit of the martyr here: there was the spirit of the Stoic. The martyr, in the midst of his sufferings, was sustained by the hope of an eternal reward: the poor driver before Sevastopol had no reward of any kind to look forward to. "Drivers at that time had no hope of promotion, or of bettering their condition; and the most they could look forward to, if very steady, was to become some officer's second bâtman towards the close of their services" (p. 218). Without entering into any discussion upon the promotion of drivers, we may say this,—Had diminutive stature been a bar to advancement in the higher ranks of the Army and Navy, the world would never have heard of Peterborough, Luxembourg, Nelson, Wellington, or Napoleon.

It would be impossible here to follow "C Troop" through its various gallant exploits in the Crimea. Had we space to do so, it would be an injustice to Colonel Whinyates; for the stirring story would only lose by being compressed or curtailed.

There is one reflection that will occur to many minds in reading this

simple and unadorned tale of the prolonged and extraordinary sufferings and privations endured by our officers and men in the Crimea; of their patience, their determination, and their gallantry. This reflection is, that some of us have been in rather too great haste to let the heroism displayed by our troops in the Crimea, to say nothing of the Peninsula, drop into oblivion. To do so is to deal a death-blow at one of the most powerful moral influences that can inspire men going under fire—*esprit de corps*. What is a "crack" Regiment? Sir Charles Napier defined it to be "a Regiment commanded by an Adjutant, with the Mess in debt, and unfit for service." But this is only the Napierean definition, made in very bad humour. A crack Regiment, or Battery, is one in which the men are proud of themselves and their corps, *in consequence of past gallant services*. They invariably fight well, because they have something very precious to lose by fighting ill—their reputation. But, we are told, there is nothing to interest the "military student" (whoever he may be) in either the Peninsular or Crimean campaigns. Everything depends, of course, upon what the student may take an interest in. Is it changes in Tactics? The line formation of Wellington, for which Sir John Moore paved the way in the Camp at Shorncliffe, was as startling an innovation in 1809 as the *gestreute gefecht* in 1870. It was a new departure in Tactics, there being little analogy between the lines of Frederick the Great and those of Wellington. Indeed, it appears to us that were "Johnnie Kincaid of the Rifle Brigade" (Sir John Kincaid) to rise from the dead, he would find little that is new in the last German work on Tactics. His most amusing book, "Random Shots of a Rifleman," contains all the germs of the present attack in skirmishing order. Is the genius of a commander interesting? Then we have yet to hear of greater proofs of genius than those offered by the passage of the Douro, the lines of Torres Vedras, the battle of Salamanca, and the the battle of Vittoria. Are examples of desperate courage interesting? If the taking of Badajos, the battle of Albuera, and the battle of Inkerman do not supply such, then the word "heroism" is a word without a meaning.

C Troop owes, as we have said, a heavy debt of gratitude to their old Major for his admirable history of their services. But we, all of us, owe him a debt of gratitude for showing us in his book one of the readiest means of increasing *esprit de corps* in our Batteries. Batteries may have to change their names and their denominations, but their past services are unchanging and unchangeable. For some years past considerable pains have been taken to perfect the Records of Service of Batteries, and no better step could have been taken. The better the men are acquainted with the past services of their Battery the prouder they will be of it, and the more determined that its future shall not disgrace its past.

For many years Colonel Whinyates has kept one of his talents wrapped in a napkin and buried in the earth. We all knew him to be an excellent Officer, but no one, before the publication of his book, suspected him of having the pen of a ready and agreeable writer.

NOTES:

BY VARIOUS HANDS.

Cricket, 1884.

A bitterly cold east and north-east wind quite prevented any practice at the nets before the 7th of May; but suddenly the weather changed, and the opening day for Royal Artillery cricket was as fine as could be wished. The weather, too, prevented the usual work on the cricket-field, but on the 10th a tolerably good wicket was ready for the opening match—Officers *v.* N.-C. Officers. It was decided last year that none but Officers quartered in Woolwich should play in this match, and this gave a good opportunity for finding out new talent. The score will show the result of the day's play :—

Non-Commissioned Officers.

1st Innings.		*2nd Innings.*	
Sergt.-Major Neill, c Wedderburn, b Rodwell	14	b Belfield	9
Bombardier Green, b King	4	b Belfield	0
Corporal Williams, c Rodwell, b King...	11	b King	3
Sergt. Hunter, b Belfield	33	c Stephenson, b Belfield	24
Qr.-Mr.-Sergt. Bilton, b Stephenson	0	b Belfield	7
〃 March, b Stephenson	0	b Belfield	0
〃 Woods, c and b Davidson	8	c MacFarlan, b Davidson	2
〃 Hall, b Davidson	1	c MacFarlan, b Davidson	0
Bombardier McDonald, not out	13	b Stephenson	7
〃 Thompson, b King	2	not out	4
Schoolmaster Edmonds, run out	4	b Belfield	0
Sergt. Goleswortby, c Synge, b King	0	c MacFarlan, b Belfield	0
Byes 7, leg byes 1, wide 1	9	Byes 5, leg byes 1, wide 1 ...	7
Total	99	Total	63

Officers.

1st Innings.		*2nd Innings.*	
C. D. King, c McDonald, b Goleswortby	0		
J. P. Du Cane, run out	44	not out	5
Major-General MacFarlan, b Goleswortby...	4		
Captain Stephenson, b McDonald	1		
W. H. O'Neill, b McDonald	7		
E. J. Phipps-Hornby, b Goleswortby	3		
A. S. Wedderburn, b Hunter...	20		
Captain Davidson, st Woods, b Goleswortby	46		
S. Belfield, c March, b Goleswortby	8		
R. M. Rodwell, b Goleswortby	0		
W. M. T. Synge, not out	5	not out	5
Byes 6, leg byes 3, wides 5	14	Byes	1
Total	152	Total	11

ROYAL ARTILLERY v. FREE FORESTERS.

WOOLWICH, 2ND AND 3RD JUNE.

ROYAL ARTILLERY.

1st Innings.		2nd Innings.	
Mr. J. P. Du Cane, b Robertson	51	b Maude...	5
Major P. K. L. Beaver, st Griffiths, b Goldney ...	21	b Burge	8
Mr. F. E. Allsopp, c Griffiths, b Robertson ...	23	run out	45
Capt. Bannatine, c Griffiths, b Robertson	0	l b w, b Maude	35
Capt. Coker, c Griffiths, b Robertson	2	b Burge	15
Capt. Stephenson, not out	33	c Coxhead, b Burge	18
Mr. C. D. King, c Robertson, b Maude	15	c Gurdon, b Burge	41
Capt. Davidson, b Robertson	4	st Gurdon, b Burge	5
Capt. Hardy, c Gurdon, b Robertson	13	not out	25
F. H. Crampton, c Baker, b Maude	7	c Spens, b Robertson	13
Capt. Boteler, c Coxhead, b Maude	3	c Hornby, b Burge	3
Byes 5, leg byes 3, wide 1, no ball 1 ...	10	Byes 12, leg byes 9, wide 1 ...	22
Total	182	Total	235

FREE FORESTERS.

1st Innings.		2nd Innings.	
Mr. F. W. Maude, c Du Cane, b Allsopp	34	b Crampton	10
Capt. Spens, c Hardy, b Bannatine	0	c and b Allsopp	52
Mr. C. Gurdon, b Allsopp	18	b Crampton	17
Mr. J. Robertson, l b w King	0	not out	93
Major Wallace, c and b Crampton	3	c Bannatine, b Crampton	17
Mr. G. R. Burge, b Crampton	25	c and b Allsopp	35
Mr. F. C. Coxhead, b Crampton	19	not out	0
Mr. E. Phipps-Hornby, b Crampton	0		
Mr. G. H. Goldney, c King, b Bannatine	17		
Capt. Baker, not out	32		
H. T. Griffiths, c Hardy, b Crampton	12		
Byes 10, leg byes 7, wide 1	18	Byes 12, leg byes 4	16
Total	178	Total	240

ROYAL ARTILLERY v. ROYAL MILITARY ACADEMY.

WOOLWICH, 6TH AND 7TH JUNE.

ROYAL MILITARY ACADEMY.

1st Innings.		2nd Innings.	
T. L. Coxhead, b Allsopp	0	b Bannatine	0
J. A. H. Bigge, b Milles...	0	c Synge, b Allsopp	5
A. W. Medley, c Allsopp, b Milles	9	not out	0
W. C. Hedley, b Milles	9	c Boteler, b Allsopp	6
A. G. Norris, b Milles	16	c Davidson, b Bannatine	0
A. E. J. Perkins, c Stephenson, b Milles	19	c Milles, b Allsopp	3
F. D. Quinton, b Allsopp	2	b Milles	7
P. Decie, c and b Davidson	14	c Synge, b Davidson	41
W. C. Stavely, c and b Bannatine	21	b Bannatine	4
C. H. De Rougemont, l b w, b Allsopp	22	b King	2
E. R. Stokes-Roberts, not out	5	st Bannatine, b Davidson	0
Byes 8, leg byes 2	10	Byes 2, leg byes 1	3
Total	127	Total	71

ROYAL ARTILLERY.

1st Innings.		2nd Innings.	
Lieut. J. P. Du Cane, c De Rougemont, b Medley	0	b Bigge	7
Lieut. C. D. King, b Coxhead	10	b Hedley	9
Lieut. F. E. Allsopp, c Decie, b Medley	15	st De Rougement, b Medley ...	3
Capt. Bannatine, b Coxhead	0	b Hedley	28
Capt. Stephenson, b Coxhead	0	st De Rougemont, b Medley ...	25
Capt. Davidson, c Bigge, b Medley	61	c P. Decie, b Bigge	65
Capt. Hon. A. Sidney, run out	2	b Hedley	1
Lieut. E. J. Phipps-Hornby, b Medley	2	b Hedley	20
Lieut. L. W. Milles, b Medley	24	b Hedley	0
Capt. Boteler, c De Rougemont, b Medley... ...	13	not out	12
Lieut. W. M. T. Synge, not out	4	b Hedley	3
Byes 5, leg byes 3, wide 2	10	Byes 1, leg byes 4, wide 1 ...	6
Total	141	Total	179

ROYAL ARTILLERY *v.* B B.

WOOLWICH, 13TH AND 14TH JUNE.

B B.

	1st Innings.		2nd Innings.	
Mr. F. A. Mackinnon, c Stephenson, b Pratt	...	21	b Allsopp	4
Mr. E. F. S. Tylecote, c Hornby. b Pratt ...	...	38	c Bannatine, b Pratt	39
Lord Throwley, b Bannatine	...	28	b Allsopp	9
Mr. W. H. Patterson, st Davidson, b Allsopp	...	95	c and b Bannatine	115
Mr. W. Foord Kelcey, run out	...	0	b Boteler	3
Mr. G. Streatfield, b Pratt	...	0	st Davidson, b Bannatine	27
Mr. L. N. D'Aeth, b Allsopp	...	12	b Bannatine	37
Hon. V. Parnell, c Hornby, b Boteler	...	6	not out	31
Mr. L. H. Fowler, l b w Bannatine	...	4	c and b Davidson	13
Mr. C. Penrose, not out	...	2	b Pratt	13
Mr. W. L. Pemberton, absent	...	0		
Byes 4, leg byes 2, wide 2	...	8	Byes 8, leg byes 4, wide 6 ...	18
Total ...	...	214	Total	309

ROYAL ARTILLERY.

1st Innings.

Capt. Davidson, b Foord Kelcey	5
Lieut. J. P. Du Cane, b Lord Throwley	14
Lieut. F. E. Allsopp, b Foord Kelcey	39
Capt. Coker, c Patterson, b Foord Kelcey	44
Capt. Bannatine, b Foord Kelcey...	34
Capt. Stephenson, b Foord Kelcey	10
Lieut. H. De Robeck, b Lord Throwley	16
Lieut. E. Phipps-Hornby, not out	16
Capt. Pratt, b Foord Kelcey	0
Capt. Boteler, b Lord Throwley	0
Lieut. W. M. T. Synge, b Lord Throwley	5
Byes 18, leg byes 3, wide 3, no ball 2	26
Total	209

The 2nd Innings of B B was not finished until 6 o'clock, and the R.A. did not commence their 2nd Innings.

AT a General Meeting of the Officers, Royal Artillery, Woolwich, it was decided to discuss the advisability of selecting New Colors for Cricket, and other games. A Committee having been formed for that purpose, Officers having any suggestions to make, are requested to send them to the Secretary, with patterns, as soon as possible.

E. J. PHIPPS-HORNBY,

Lieutenant, R.H.A.,

Hon. Sec.

It would help the Secretary of the Cricket Club very much if Officers at out-stations would kindly comply with the request at the bottom of the cards, asking them to send their names for any match in which they are desirous of playing.

Appointments in the Ordnance Store Department.

Appointments in the Ordnance Store Department being now open to Officers of the Royal Artillery, some of the latter may be glad of a little information on the subject in a condensed form.

When a vacancy occurs it may be filled by the appointment of a Royal Artillery Officer of five years' service and upwards, to the rank of Deputy-Assistant-Commissary-General of Ordnance. He is appointed for one year on probation, during which year he draws the pay of his departmental rank, viz., 12s. 6d. per diem, but is permitted to continue wearing the uniform of the Royal Artillery. When seconded in his Regiment (after three months' service in the Department) he is (if a subaltern) granted the temporary rank of Captain in the Army.

The appointment is for five years, renewable for another five. At the close of ten years' service he must elect either to return to his Regiment or to permanently join the Department, resigning his combatant commission. At the expiration of the probationary year he must provide himself with the uniform of the Department, which, however, is easy altered from the Royal Artillery uniform, the greatcoat being the only item which will not bear alteration. New belts, both dress and undress, are necessary.

On joining the Department, the new-comers are placed at the bottom of the Roster for Foreign Service. The latter is also very limited in the Department—generally five years at Mediterranean, and three at other stations. There is no Indian Service.

The pay of a D.-A.-C.-G. is increased to 15s. per diem after three years' Departmental service (probationary period inclusive). The pay of the next rank is 25s. per diem. A D.-A.-C.-G. draws allowances at the rates for a Staff Captain, and, if provided with quarters, is entitled to three rooms and a kitchen. The quarters of the Department are usually very good ones—such as a married Officer could live in comfortably. Moreover, an Officer's station is generally a fixed one for some years at least.

Prospects of promotion in the Department are not very promising at present, but will probably improve in a year or two, when the retirements on account of age begin to take effect. In the higher ranks it is entirely by selection, and the present Commissary-General of Ordnance is an old Artillery Officer.

At several stations extra pay is granted for the performance of special duties.

Officers of the Department are all mounted in time of war, and the ranks below Field Officer are provided with public service horses and saddlery.

Referring to page 3 of "Notes," issued with No. 11, Vol. XII., of R.A. Institution "Proceedings," Officers are informed that the form of questions was intended to be detached, and the answers written opposite the questions. The words "Foreign stations only," at the head of p. 4, refers to question 8 only, and not to the whole page as it would seem to imply.

THE CALCULATION OF TRAJECTORIES IN DIRECT AND CURVED FIRE.

BY

A. G. GREENHILL, M.A.,

(Professor of Mathematics to the Advanced Class of Artillery Officers).

I.

In the present article it is proposed to explain how the results of the experiments of the Rev. F. Bashforth, B.D., on the resistance of the air to elongated projectiles are applied to the construction of a Gunnery Table, similar in arrangement to the tables of Rev. F. Bashforth and Mr. W. D. Niven, but more condensed, and calculated in a more elementary manner; and to illustrate the use of the Table by a selection of practical examples.

1. According to the official terminology (*"Handbook for Field Service," 1878, p. 288; Sladen's "Principles of Gunnery," 1879, p. 3*), the fire of guns is defined as—

Direct, when firing with full charges and elevations not exceeding 15°.

Indirect or Curved, when firing with guns, howitzers, or mortars, and reduced charges with elevations not exceeding 15°.

High Angle, when firing with elevations exceeding 15°.

In the first two cases, namely of Direct and Curved Fire, the curvature of the path of the projectile is in general so slight that it is sufficient in calculating the trajectory to begin by neglecting gravity. The motion of the projectile will then be considered as affected only by the resistance of the air, and the path as a straight line; afterwards the effect of gravity, in producing the slight curvature of the path, will be taken into account.

This method of calculating trajectories is very convenient in practice; for although in theoretical investigations the data are usually the initial conditions of elevation and velocity, and it is required to determine the range, time of flight, angle of descent, &c.; yet in actual practice the inverse problem is generally presented for solution, namely, to determine the necessary elevation for a certain range previously determined by measurement, range-finders, or by guess

work: or it may be required to attack a certain defensive work with a certain angle of descent; and the best position for the gun, and the requisite elevation and charge of powder required to give the requisite initial velocity are to be calculated.

In the third case of High Angle Fire, on the contrary, the resistance of the air is neglected as a first approximation, and gravity only taken into account, and then the trajectory is considered to be a parabola, the velocities being generally small enough, and the weight of the projectile large enough, in this case for this approximation to be legitimate.

2. It is assumed, as the result of the experiments of Mr. Bashforth, Herr Krupp, and others on the motion of elongated projectiles, that the resistance of the air may be represented in its effect by a pressure per unit of area acting uniformly over the head of the projectile, which pressure is proportional to the density of the air, and is some function of the velocity of the projectile.

No mathematical expression has yet been discovered for this function of the velocity which will hold over any considerable range of the velocity: so we are compelled to tabulate the values as determined from as great a range of experiments as possible.

Such experiments were carried out by Mr. Bashforth in 1865–1870, and again in 1878–1880; and the results of his experiments are tabulated in the "*Reports on the Experiments made with the Bashforth Chronograph, &c., 1865–1870;*" and in the "*Final Report on Experiments made with the Bashforth Chronograph to determine the Resistance of the Air to the Motion of Elongated Projectiles, 1878–1880.*"

Denoting the pressure on the head of the projectile, estimated in *pounds* on the *circular inch* by p when the velocity is v feet per second; then d^2p is the resistance of the air in lb. to a projectile d inches in diameter, and p is the resistance of the air, in lb., to a projectile one inch in diameter.

The following Table (I.), calculated by Mr. A. G. Hadcock, (son of Capt. G. Hadcock, retired Riding Master, R.A.), from the results of Mr. Bashforth's experiments of 1878–1880, gives the corresponding values of v and p for elongated projectiles having ogival heads struck with a radius of one and a half calibres, the density of the air being 534·22 grains to the cubic foot, corresponding to a height of 30 inches of the barometer at a temperature of 62° F., and $g = 32{\cdot}1908$.

Mr. Bashforth tabulates the result of his experiments on the resistance of the air in the form of the values of a certain coefficient K, such that the resistance P of the air in lb. to a projectile d inches in diameter, moving with velocity v feet per second, is given by—

$$P = d^2 \frac{K}{g}\left(\frac{v}{1000}\right)^3,$$

and therefore p, K, and v are connected by the relation—

$$p = \frac{K}{g}\left(\frac{v}{1000}\right)^3,$$

by means of which p, in Table I., was calculated.

TABLE I.

v	p	v	p	v	p	v	p	v	p	v	p
100	·0180	455	·3901	810	1·248	1165	5·387	1520	10·493	2120	20·010
105	·0198	460	·3992	815	1·268	1170	5·454	1525	10·546	2130	20·294
110	·0217	465	·4082	820	1·288	1175	5·526	1530	10·601	2140	20·551
115	·0237	470	·4174	825	1·310	1180	5·594	1535	10·656	2150	20·811
120	·0259	475	·4269	830	1·334	1185	5·669	1540	10·712	2160	21·072
125	·0281	480	·4360	835	1·356	1190	5·738	1545	10·775	2170	21·336
130	·0303	485	·4456	840	1·381	1195	5·812	1550	10·829	2180	21·633
135	·0327	490	·4547	845	1·406	1200	5·884	1555	10·884	2190	21·889
140	·0352	495	·4642	850	1·431	1205	5·954	1560	10·945	2200	22·158
145	·0378	500	·4734	855	1·456	1210	6·032	1565	11·000	2210	22·429
150	·0404	505	·4829	860	1·482	1215	6·103	1570	11·060	2220	22·702
155	·0431	510	·4928	865	1·508	1220	6·183	1575	11·120	2230	23·010
160	·0459	515	·5024	870	1·534	1225	6·258	1580	11·175	2240	23·288
165	·0489	520	·5124	875	1·561	1230	6·331	1585	11·238	2250	23·566
170	·0519	525	·5295	880	1·588	1235	6·406	1590	11·288	2260	23·848
175	·0550	530	·5318	885	1·615	1240	6·486	1595	11·348	2270	24·132
180	·0582	535	·5418	890	1·643	1245	6·563	1600	11·416	2280	24·368
185	·0615	540	·5517	895	1·670	1250	5·637	1605	11·463	2290	24·583
190	·0648	545	·5622	900	1·699	1255	6·714	1610	11·540	2300	24·760
195	·0683	550	·5721	905	1·727	1260	6·791	1615	11·585	2310	24·887
200	·0718	555	·5826	910	1·756	1265	6·873	1620	11·662	2320	24·987
205	·0755	560	·5931	915	1·785	1270	6·948	1625	11·716	2330	25·071
210	·0792	565	·6035	920	1·814	1275	7·025	1630	11·784	2340	25·152
215	·0830	570	·6139	925	1·844	1280	7·101	1640	11·909	2350	25·242
220	·0869	575	·6243	930	1·874	1285	7·178	1650	12·030	2360	25·316
225	·0909	580	·6339	935	1·905	1290	7·256	1660	12·150	2370	25·386
230	·0950	585	·6442	940	1·935	1295	7·335	1670	12·268	2380	25·467
235	·0992	590	·6539	945	1·966	1300	7·413	1680	12·404	2390	25·529
240	·1035	595	·6642	950	1·998	1305	7·485	1690	12·536	2400	25·588
245	·1078	600	·6743	955	2·029	1310	7·569	1700	12·666	2410	25·653
250	·1122	605	·6845	960	2·061	1315	7·640	1710	12·801	2420	25·710
255	·1168	610	·6952	965	2·094	1320	7·723	1720	12·900	2430	25·772
260	·1214	615	·7060	970	2·127	1325	7·796	1730	13·059	2440	25·814
265	·1261	620	·7166	975	2·160	1330	7·879	1740	13·191	2450	25·898
270	·1310	625	·7273	980	2·193	1335	7·954	1750	13·318	2460	26·008
275	·1358	630	·7386	985	2·227	1340	8·034	1760	13·466	2470	26·071
280	·1409	635	·7500	990	2·261	1345	8·106	1770	13·591	2480	26·158
285	·1458	640	·7615	995	2·295	1350	8·185	1780	13·733	2490	26·276
290	·1511	645	·7728	1000	2·330	1355	8·256	1790	13·862	2500	26·406
295	·1562	650	·7840	1005	2·365	1360	8·339	1800	14·002	2510	26·534
300	·1616	655	·7961	1010	2·404	1365	8·411	1810	14·149	2520	26·709
305	·1671	660	·8081	1015	2·443	1370	8·490	1820	14·269	2530	26·866
310	·1727	665	·8205	1020	2·482	1375	8·561	1830	14·414	2540	27·039
315	·1783	670	·8325	1025	2·533	1380	8·639	1840	14·552	2550	27·243
320	·1841	675	·8445	1030	2·604	1385	8·708	1850	14·696	2560	27·464
325	·1899	680	·8565	1035	2·700	1390	8·784	1860	14·832	2570	27·736
330	·1959	685	·8688	1040	2·823	1395	8·857	1870	14·949	2580	28·010
335	·2020	690	·8807	1045	2·970	1400	8·924	1880	15·090	2590	28·337
340	·2083	695	·8926	1050	3 139	1405	8·989	1890	15·224	2600	28·613
345	·2146	700	·9048	1055	3·313	1410	9·066	1900	15·364	2610	28·945
350	·2211	705	·9177	1060	3·478	1415	9·135	1910	15·496	2620	29·279
355	·2278	710	·9306	1065	3·625	1420	9·206	1920	15·656	2630	29·562
360	·2346	715	·9434	1070	3·756	1425	9·274	1930	15·809	2640	29·899
365	·2415	720	·9577	1075	3·882	1430	9·349	1940	15·968	2650	30·241
370	·2485	725	·9717	1080	3·999	1435	9·414	1950	16·127	2660	30·527
375	·2558	730	·9861	1085	4·114	1440	9·489	1960	16·302	2670	30·873
380	·2631	735	1·0002	1090	4·221	1445	9·554	1970	16·484	2680	31·221
385	·2707	740	1·0146	1095	4·322	1450	9·622	1980	16·689	2690	31·494
390	·2784	745	1·0288	1100	4·420	1455	9·687	1990	16·888	2700	31·846
395	·2863	750	1·0433	1105	4·516	1460	9·753	2000	17·096	2710	32·203
400	·2943	755	1·0574	1110	4·605	1465	9·822	2010	17·305	2720	32·500
405	·3025	760	1·0733	1115	4·682	1470	9·879	2020	17·515	2730	32·859
410	·3110	765	1·0888	1120	4·766	1475	9·940	2030	17·752	2740	33·222
415	·3194	770	1·1062	1125	4·843	1480	10·013	2040	17·990	2750	33·586
420	·3280	775	1·1237	1130	4·913	1485	10·074	2050	18·229	2760	33·955
425	·3366	780	1·1408	1135	4·978	1490	10·133	2060	18·463	2770	34·325
430	·3453	785	1·1585	1140	5·041	1495	10·210	2070	18·706	2780	34·697
435	·3542	790	1·1764	1145	5·111	1500	10·263	2080	18·978	2790	35·073
440	·3630	795	1·1938	1150	5·179	1505	10·323	2090	19·227	2800	35·453
445	·3720	800	1·2119	1155	5·247	1510	10·384	2100	19·504	—	—
450	·3810	805	1·2301	1160	5·315	1515	10·433	2110	19·755	—	—

The coefficient K will be found tabulated in Bashforth's *"Motion of Projectiles,"* 1872; and also in the *"Final Report of Experiments made with the Bashforth Chronograph,"* 1880.

Between the velocities of 1090, the velocity of sound, and 1400, formerly the useful range of velocities in gunnery, the value of K is very nearly constant, and it consequently may be assumed that the resistance of the air varies as the cube of the velocity, the mathematical assumption which most simplifies the numerical calculations of the experiments.

Outside these limits of velocity, however, the value of K changes rapidly.

3. The advantage of the use of the coefficient K may be explained in the following manner:—

In Mr. Bashforth's experiments a number of equidistant screens, 150 feet apart, were erected, and a shot being fired through them, the instant of time of the passage through each screen was recorded by an electrical arrangement in the Bashforth Chronograph.

If these instants were measured in seconds and decimals of a second from an arbitrary origin of time, it was found by differencing these intervals of time that the second differences were very nearly constant, and could be made constant by slight arbitrary corrections applied to the Chronograph observations.

The second differences of the time being constant for equal intervals of distance, justifies the assumption that the time is a quadratic function of the distance, or that—

$$t = as + bs^2.$$

For if l denote the distance between the screens, and t_s the time up to any screen at a distance s from an arbitrary origin; then if—

$$t_s = as + bs^2$$

$$t_{s+l} = a(s+l) + b(s+l)^2$$

and therefore
$$\Delta t_s = t_{s+l} - t_s$$
$$= al + b(2sl + l^2).$$

Also
$$\Delta t_{s+l} = al + b\{2(s+l)l + l^2\}:$$

therefore
$$\Delta^2 t_s = \Delta t_{s+l} - \Delta t_s$$
$$= 2bl^2, \text{ a constant.}$$

But if
$$t = as + bs^2,$$

then
$$\frac{dt}{ds} = \frac{1}{v} = a + 2bs,$$

also
$$\frac{d^2t}{ds^2} = 2b;$$

and
$$\frac{d^2s}{dt^2} = -\frac{d^2t}{ds^2}\left(\frac{ds}{dt}\right)^3 = -2b\left(\frac{ds}{dt}\right)^3 = -2bv^3,$$

and the retardation, and therefore the resistance, varies as the cube of the velocity.

In any case, however, whatever be the differences (Boole, *Finite Differences*)—

$$l\frac{dt}{ds} = \Delta t - \tfrac{1}{2}\Delta^2 t + \tfrac{1}{3}\Delta^3 t - \tfrac{1}{4}\Delta^4 t + \quad . \quad . \quad . \quad . \quad .$$

$$l^2\frac{d^2t}{ds^2} = \Delta^2 t - \Delta^3 t + \tfrac{11}{12}\Delta^4 t - \tfrac{5}{6}\Delta^4 t + \quad . \quad . \quad . \quad . \quad .$$

so that if we put $\frac{d^2t}{ds^2} = 2b$, then the retardation due to the resistance

$$= -\frac{d^2s}{dt^2} = \frac{d^2t}{ds^2}\left(\frac{ds}{dt}\right) = 2bv^3.$$

(Bashforth, *Motion of Projectiles*, chap. iii.)

Since the resistance is assumed to vary as the cross-sectional area of the projectile, and the retardation is proportional to the resistance, and inversely proportional to the weight of the projectile: therefore if we put the retardation—

$$2bv^3 = k\frac{d^2}{W}v^3,$$

then
$$k = 2b\frac{W}{d^2},$$

a coefficient the same for all projectiles of the same shape.

It is found by experiment that with our units k is a very small quantity, expressed by a decimal, the significant figures not beginning till the 7th or 8th place : Mr. Bashforth puts—

$$k \times 10^9 = K,$$

and tabulates the coefficient K; and then the retardation—

$$2bv^3 = \frac{d^2}{W}Kv^3 \times 10^{-9} = \frac{d^2}{W}K\left(\frac{v}{1000}\right)^3;$$

equivalent to taking 1000 f.s. as the unit velocity.

For example, from experiments in 1867, Mr. Bashforth found with the 3-inch gun, firing a projectile of 12 lb., at a mean velocity of 1159, the mean value of—

$$\Delta^2 t_s = 2bl^2 = \cdot 001812.$$

(*Reports on Experiments made with the Bashforth Chronograph*, 1865–70, *p.* 39).

The screens being 150 feet apart, $l = 150$, and therefore—

$$2b = \cdot 000000080533;$$

and
$$k = 2b\frac{W}{d^2}$$

$$= \cdot 00000010738;$$

therefore
$$K = 107\cdot 38.$$

4. It is instructive to notice the correspondence between the values of p, estimated in lb. per circular inch, at a velocity of v feet per second, and a density of air of 534·22 grains per cubic foot according to the experiments of Mr. Bashforth with the values obtained experimentally by Herr Krupp, in 1879, at Meppen, for the pressure of the air on the head of the projectile in kilogrammes per centimètre square, which he denotes by D, at a velocity of V mètres per second and a density of air of 1·206 kg. per mètre cube, equivalent to a density of 527 grains per cubic foot.

The table of the corresponding values of V and D will be found in "*Table de Krupp, pour le calcul des vitesses restantes horizontales et des durées de trajet des projectiles oblongs.*" Essen. 1881.

The ogival head of the projectile in Mr. Bashforth's experiments is, supposed, struck with a radius of one and a half calibres, and in Krupp's experiments with a radius of two calibres.

Since one mètre $= 3·28$ feet,

therefore $v = 3·28\, V$;

$$\text{or } \log v = ·5158738 + \log V.$$

And since one kilogramme $= 2·205$ lb.,

one square inch $= 6·4516$ square centimètres,

therefore
$$p = \tfrac{1}{4}\pi \times 2·205 \times 6·4516\, D,$$
$$= 11·173\, D;$$
$$\text{or } \log p = 1·0481669 + \log D.$$

The diagram, drawn by Mr. Hadcock, exhibits to the eye the corresponding values of v and p by means of curves; curve A is drawn for the elongated projectiles experimented with by Mr. Bashforth in 1878–80; curve B connects v and p for elongated projectiles according to the experiments of Krupp, the head being struck with a radius of two diameters, and the density of the air 527 grains to the cubic foot; curve C connects v and p for spherical projectiles according to Bashforth's experiments of 1865–70, the density of the air being 530·6 grains to the cubic foot.

Krupp's curve B lies below Bashforth's curve A, indicating a smaller resistance of the air to Krupp's projectiles, due partly to the sharper point and the better centreing of the projectile obtainable with a breech-loading system, and partly, in a slight degree, to the smaller density of the air.

Two inflexions will be observed in the curve A, one in the neighbourhood of the value $v = 1090$, the velocity of sound; and the other in the neighbourhood of $v = 2413$, the velocity of air in rushing into a vacuum.

Below the velocity of sound the projectile is always moving in disturbed air; above the velocity of sound the projectile is penetrating undisturbed air; and again above the velocity 2413 a vacuum is formed in the rear of the projectile.

These considerations, and the irregular nature of the curve in the diagram, will show the impossibility of obtaining any simpler mathematical expression, or function, connecting p and v.

An inspection of the curve A in the diagram seems to indicate that up to the velocity of sound the curve is a parabola, indicating that the resistance varies as the square of the velocity; afterwards, up to the velocity 2413, the curve appears to be the parabola pushed upwards a constant distance, indicating that the resistance is of the form $a + bv^2$; above the velocity 2413 the curve appears to rejoin the original parabola.

5. When gravity is neglected, and the resistance of the air alone is taken into account, the centre of gravity of the projectile will move in a straight line, only on the supposition that the direction of motion coincides exactly with the axis of the projectile.

This state of motion would be highly unstable, unless a sufficient rotation were imparted to the projectile by the rifling of the gun; a slight departure, due to imperfect centreing, of the direction of motion from the direction of the axis of the projectile will then cause the centre of gravity to describe a sinuous helical path, departing slightly from a straight line.

The resistance of the air will not, so far as we know, be sensibly altered on this account, so that in applying the preceding experimental data, the motion of the projectile may be considered rectilinear. (*Vide* communications by Rev. F. Bashforth to "*Nature*," 3 April, 1884.)

The amount of rotation required for the stability of motion of an elongated projectile, has been investigated in the "Proceedings of the R. A. Institution," Vol. X., on certain hypotheses, and a table has been drawn up by Captain J. P. Cundill, R.A., showing the twist required in number of turns to a calibre for different projectiles.

6. In applying the preceding experimental data to the construction of the Gunnery Table, let—

d = diameter of the projectile in *inches*;
W = weight " " *pounds*;
v = velocity " " f.s.;
P = resistance of the air in lb.;
p = pressure of the air in lb. per circular inch on the head of the projectile; (then $P = d^2p$);
t = time of flight in *seconds*;
s = distance traversed in *feet*.

If f denote the retardation of the projectile at any instant, then—

$$\frac{f}{g} = \frac{P}{W}, \text{ or } f = \frac{P}{W}g = \frac{d^2}{W}pg.$$

If Δv denote the loss of velocity in the interval of time Δt, then—

$$\frac{\Delta v}{\Delta t} = \text{mean retardation in the interval } \Delta t,$$

$$= f = \frac{d^2}{W}pg,$$

where p denotes the mean pressure of the air in the interval.

Therefore
$$\frac{d^2}{W}\Delta t = \frac{\Delta v}{pg};$$

or putting
$$\frac{d^2}{W}t = T, \text{ then}$$

$$\Delta T = \frac{\Delta v}{pg}.$$

Since p is tabulated as a function of v, the velocity v is taken as the argument of the table, and successively equal to 100, 110, 120, 130, 140, ... ; so that Δv is constantly equal to 10.

The mean value of p in every interval is taken as that corresponding to the arithmetic mean velocity, that is 105, 115, 125, 135, ...

Taking the corresponding value of p, and putting $\Delta v = 10$, then—

$$\Delta T = \frac{10}{gp}$$

was calculated, and tabulated in the first column of differences, under the heading ΔT.

Afterwards the differences ΔT were summed by means of the Arithmometer in the R. A. Institution, and tabulated in the column under the heading T.

As an example, consider the interval of time during which the velocity falls from 410 to 400.

Then the mean velocity in the interval—

$$v = 405,$$

and the corresponding mean value of—

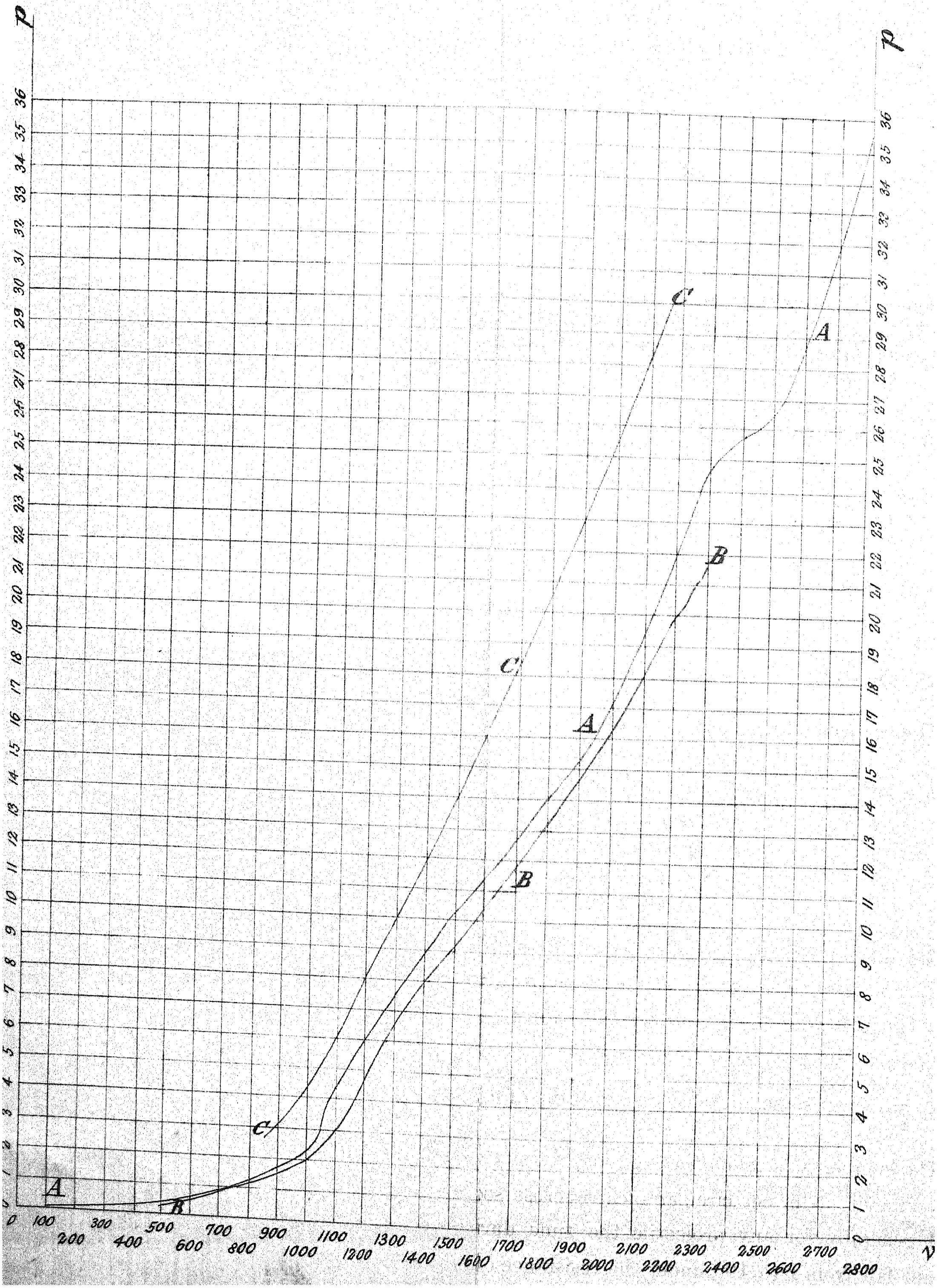
$$p = \cdot 3025.$$

Then
$$\log p = \bar{1}\cdot 48077,$$
$$\log g = 1\cdot 50773,$$
$$\log gp = \cdot 98850,$$
$$\log \Delta T = \cdot 01150;$$
$$\Delta T = 1\cdot 0268.$$

The number T, sometimes denoted by T_v or T_v^{100}, is called the reduced time; and is equal to the number of seconds a projectile, for which $\frac{W}{d^2} = 1$, would take for the velocity to fall from v to 100 under the influence of the resistance of the air.

$\frac{W}{d^2} = 1$ for instance in a 3-inch projectile of 9 lb.

The number $\frac{W}{d^2}$ is called the sectional density of the projectile; it is the number of lb. per circular inch of cross section of the projectile; and generally for any projectile the time during which the velocity would fall from v to 100 under the resistance of the air is $\frac{W}{d^2}T$.


p
v
A
B
C
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000 2100 2200 2300 2400 2500 2600 2700 2800

The reduced time during which the velocity of the projectile would fall from any initial velocity V to any final velocity v is denoted by T_V^v;

and
$$T_V^{v} = T_V^{100} - T_v^{100}$$
$$= T_V - T_v;$$

and the actual number of seconds during which the velocity will fall from V to v will be—

$$\frac{W}{d^2} T_V^v = \frac{W}{d^2}(T_V - T_v),$$

where $\frac{W}{d^2}$ is the sectional density of the projectile.

7. Next let Δs denote the number of feet traversed in the time Δt.

Then
$$\Delta s = v\Delta t,$$
if
$$v = \text{mean velocity in the interval } \Delta t.$$

Putting
$$\frac{d^2}{W} s = S$$
and
$$\frac{d^2}{W} t = T, \text{ as before;}$$
then
$$\Delta S = v\Delta T.$$

Assuming that the mean velocity in any interval is the arithmetic mean of the initial and final velocities; then the values of ΔT must be multiplied by 105, 115, 125, ... respectively, to obtain the corresponding series of values of ΔS.

Afterwards the differences ΔS were summed by means of the Arithmometer, and tabulated in the column under the heading S.

As an example, consider again the interval during which the velocity falls from 410 to 400.

Then
$$\Delta S = v\Delta T,$$
where
$$v = 405,$$
$$\Delta T = 1{\cdot}0268.$$

And
$$\log v = 2{\cdot}60745,$$
$$\log \Delta T = {\cdot}01150,$$
$$\therefore \quad \log \Delta S = 2{\cdot}61895,$$
and
$$\Delta S = 415{\cdot}87.$$

The number S, sometimes denoted by S_v or S_v^{100}, is called the reduced distance; and is equal to the number of feet a projectile, for which $\frac{W}{d^2} = 1$, would go, while the velocity fell from v to 100 under the influence of the resistance of the air; and generally for any projectile while the velocity fell from v to 100 the number of feet traversed would be $\frac{W}{d^2} S$.

The reduced distance during which the velocity would fall from any initial velocity V to any final velocity v is denoted by $\overset{v}{S}_V$; and

$$\overset{v}{S}_V = \overset{100}{S}_V - \overset{100}{S}_v$$
$$= S_V - S_v;$$

and the actual number of feet traversed while the velocity falls from V to v will be—

$$\frac{W}{d^2} \overset{v}{S}_V = \frac{W}{d^2}(S_V - S_v),$$

when $\frac{W}{d^2}$ is the sectional density of the projectile.

The values T and S were first calculated by Mr. Bashforth, and are tabulated by him for differences of unity in the velocity.

These tables of Mr. Bashforth will be found printed in,—

1. "*A Mathematical Theory of the Motion of Projectiles.*" By Rev. F. Bashforth, B.D.
2. "*Handbook of Field Service.*" 1878.
3. "*Principles of Gunnery.*" 1879. By Major J. Sladen, R.A.
4. "*Final Report on Experiments made with the Bashforth Chronograph.*" 1878 to 1880.
5. "*Manual of Gunnery for H. M. Fleet.*" 1880.
6. "*Text Book of Gunnery.*" 1883. By Capt. G. Mackinlay, R. A.
7. "*Problems in Gunnery.*" "Proceedings," R. A. Institution, vol. xii. 1883. By Major W. McClintock, R. A.

In the Gunnery Table the values of T and S have been re-calculated in the manner explained above, and tabulated for differences of 10 in the velocity, to make the table more compact; for intermediate velocities the rule of proportional parts must be employed.

8. The remaining columns of ΔD and D in the Gunnery Table are required in order to calculate the deviation in direction of a projectile between any initial and final velocities due to the deviating influence of gravity in a flat trajectory.

This part of the Table was devised by Mr. W. D. Niven, and will be found tabulated for differences of unity in the velocity, and printed in,—

1. "*Proceedings of the Royal Society of London.*" No. 181; 1877.
2. "*Handbook for Field Service.*" 1878.
3. "*Principles of Gunnery.*" 1879. By Major J. Sladen, R.A.
4. "*Manual of Gunnery for H. M. Fleet.*" 1880.
5. "*Text Book of Gunnery.*" 1883. By Capt. G. Mackinlay, R.A.
6. "*Problems in Gunnery.*" "Proceedings," R. A. Institution, vol. xii. By Major W. McClintock, R. A.

In order to calculate the D columns, suppose that the tangent to the

trajectory makes an angle with the horizon whose magnitude estimated in circular measure is ψ.

Then if $d\psi$ denote the infinitesimal *decrement* of ψ in the infinitesimal increment of time dt, resolving normally in the trajectory,—

$$v \frac{d\psi}{dt} = g \cos \psi.$$

The trajectory being supposed sufficiently flat for $\cos \psi$ to be replaced by unity;

$$v \frac{d\psi}{dt} = g;$$

or
$$\frac{d\psi}{dt} = \frac{g}{v};$$

and therefore
$$\frac{\Delta\psi}{\Delta t} = \frac{g}{v};$$

$\Delta\psi$ denoting the finite decrement of ψ in the finite interval of time $\Delta\psi$, and v denoting the mean velocity in the interval.

If δ denote the number of degrees in the angle whose circular measure is ψ, then—

$$\frac{\delta}{180} = \frac{\psi}{\pi},$$

or
$$\psi = \frac{\pi}{180} \delta;$$

and
$$\Delta\psi = \frac{\pi}{180} \Delta\delta.$$

Therefore
$$\frac{\pi}{180} \frac{\Delta\delta}{\Delta t} = \frac{g}{v},$$

or
$$\Delta\delta = \frac{180g}{\pi} \frac{\Delta t}{v}.$$

Putting
$$\frac{d^2}{w} \delta = D,$$

and
$$\frac{d^2}{w} t = T, \text{ as before;}$$

then
$$\Delta D = \frac{180g}{\pi} \frac{\Delta T}{v}.$$

As with low velocities the trajectory is very much curved, and the preceding approximation inapplicable, the column of ΔD is not begun till the velocity 400; and then the values of ΔD were derived from those of ΔT by multiplying by $\frac{180g}{\pi}$ and dividing by the corresponding mean velocities in each interval, namely, by 405, 415, 425, ... respectively.

Afterwards the differences ΔD were summed by means of the Arithmometer, and tabulated under the heading D.

As an example, consider again the interval during which the velocity falls from 410 to 400:

Then
$$\Delta D = \frac{180g}{\pi} \frac{\Delta T}{v},$$
where
$$v = 405$$
$$\Delta T = 1{\cdot}0268.$$

And
$$\log \frac{180g}{\pi} = 3{\cdot}2658548,$$
$$\log \ \Delta T = \ {\cdot}0115010,$$
$$\log \frac{180g}{\pi} \Delta T = 3{\cdot}2773558,$$
$$\log v = 2{\cdot}6074550,$$
$$\log \Delta D = \ {\cdot}6699008,$$
and
$$\Delta D = 4{\cdot}6763.$$

The number D, sometimes denoted by D_v or D_v^{400}, is called the reduced deviation: and is equal to the number of degrees the direction of motion of a projectile, for which $\frac{W}{d^2} = 1$, would be deviated by gravity while the velocity fell from v to 400.

Generally for any projectile the deviation would be $\frac{W}{d^2} D_v$ degrees while the velocity fell from v to 400.

This column must not however be employed over too great a range of velocity, or the deviation will become too large for the approximations to hold which have been employed.

For any initial velocity V, and final velocity v, the reduced deviation is denoted by D_V^v; and

$$D_V^v = D_V^{400} - D_v^{400},$$
$$= D_V - D_v;$$

and the actual deviation in degrees will be,—

$$\frac{W}{d^2} D_V^v = \frac{W}{d^2} (D_V - D_v),$$

when $\frac{W}{d^2}$ is the sectional density of the projectile.

The differences ΔT, ΔS and ΔD were calculated Mr. A. G. Hadcock, from the formulæ, proved above,—

$$\Delta T = \frac{10}{gp} \quad \ldots\ldots \quad (1);$$

$$\Delta S = v \Delta T \quad \ldots\ldots \quad (2);$$

$$\Delta D = \frac{180g}{\pi} \frac{\Delta T}{v} \quad \ldots\ldots \quad (3);$$

and the summation of the differences ΔT, ΔS and ΔD to form the columns T, S and D was performed by using the Arithmometer in the R. A. Institution; and the results verified by using the instrument for subtraction.

9. When the trajectory is a flat one, the vertical component of the resistance of the air is generally sufficiently small to be inappreciable; and if it be neglected, the vertical motion of the projectile will be that due to a constant vertical acceleration g, directed downwards.

If the motion be referred to two co-ordinate axes Ox and Oy, respectively horizontal and vertical, drawn through O, the muzzle of the gun; then the equation of the vertical motion will be,—

$$\frac{d^2y}{dt^2} = -g;$$

and therefore, integrating,—

$$\frac{dy}{dt} = C - gt,$$

$$= g\left(\tfrac{1}{2} T - t\right),$$

supposing T the whole time of flight in a range on a horizontal plane through O the muzzle, and therefore $\frac{1}{2}T$ the time of flight to the highest point, or vertex, of the trajectory.

Integrating again,—

$$y = \tfrac{1}{2} g (Tt - t^2)$$

$$= \tfrac{1}{2} gt (T - t)$$

$$= \tfrac{1}{2} gt t',$$

supposing t the time of flight from the muzzle up to any height y, and t' the time down to the level of the muzzle again.

Hence when $y = H$, the height of the vertex of the trajectory,—

$$t = t' = \tfrac{1}{2} T; \text{ and therefore}$$

$$H = \frac{1}{8} gT^2 = 4T^2,$$

taking $g = 32$, nearly.

Hence the practical rule—"*Four times the square of the number of seconds in the time of flight is the height of the vertex of the trajectory in feet.*"

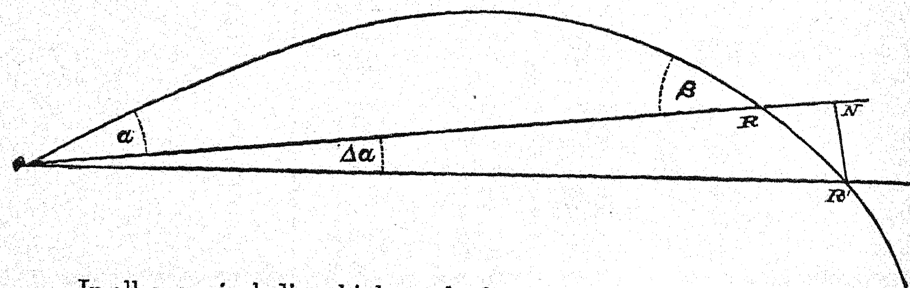
For instance, in firing with the 100-ton B.L. gun, at Spezzia, in November, 1882, the time of flight was observed to be 18·4 seconds; consequently the height of the vertex of the trajectory was 1354·24 feet.

The vertex of the trajectory is at the point of half time of flight, and beyond the point of half range, when the resistance of the air is taken into account; the second half of the trajectory being then more curved than the first.

10. The angle of departure, expressed in degrees, will be denoted by α, and the angle of descent by β.

If the resistance of the air be left out of account, then $\alpha=\beta$; but otherwise β is always greater than α.

By the use of the D columns α and β can be determined, provided they are not large.



In all cases, including high angle fire, the angle of descent, β, can be obtained at a given range, R, due to a given elevation, α, by observing the increment of range, ΔR, due to an increment $\Delta\alpha$ of the angle of elevation.

For if OR in the figure denote the range R with an elevation α, then when the elevation is increased by $\Delta\alpha$, we may, on the supposition that the trajectory is unaltered by the slight variation in the direction of gravity (a supposition called, by French writers, *l'hypothèse de la rigidité de la trajectoire*, by the Germans *das Schwenken der Bahnen*) suppose the ground instead to be deflected through an angle $\Delta\alpha$, and to take the position OR'.

Then, ultimately,—

$$\tan\beta=\frac{NR'}{RN};$$

and

$$RN=\Delta R,\quad NR'=R\,\frac{\pi}{180}\,\Delta\alpha;$$

$$\therefore\ \tan\beta=\frac{\pi}{180}\,\frac{R\Delta\alpha}{\Delta R}.$$

Another way, if possible, of measuring β would be to measure the increment of range due to firing the gun at a higher level at the same angle of elevation.

Thus if ΔR denote the increment of range in feet when the gun is fired at a level h feet higher,—

$$\tan\beta=\frac{h}{\Delta R},\ \text{approximately}.$$

GUNNERY TABLE.

v	ΔT	T_v	ΔS	S_v	ΔD	T_v
f.s.						
100	15·6890	0·0000	1647·35	0·00	—	—
110	13·0823	15·6890	1504·46	1647·35	—	—
120	11·0703	28·7713	1383·78	3151·81	—	—
130	9·4919	39·8416	1281·40	4535·59	—	—
140	8·2272	49·3335	1192·94	5816·99	—	—
150	7·2013	57·5606	1116·21	7009·93	—	—
160	6·3531	64·7620	1048·26	8126·14	—	—
170	5·6474	71·1150	988·29	9174·40	—	—
180	5·0540	76·7624	934·99	10162·69	—	—
190	4·5485	81·8164	886·96	11097·68	—	—
200	4·1161	86·3649	843·81	11984·64	—	—
210	3·7419	90·4810	804·51	12828·45	—	—
220	3·4173	94·2230	768·90	13632·96	—	—
230	3·1323	97·6403	736·09	14401·86	—	—
240	2·8813	100·7726	705·92	15137·95	—	—
250	2·6603	103·6539	678·37	15843·87	—	—
260	2·4627	106·3142	652·61	16522·24	—	—
270	2·2875	108·7768	629·07	17174·85	—	—
280	2·1301	111·0644	607·08	17803·92	—	—
290	1·9884	113·1945	586·57	18411·00	—	—
300	1·8589	115·1828	566·97	18997·57	—	—
310	1·7426	117·0418	548·92	19564·54	—	—
320	1·6356	118·7844	531·58	20113·46	—	—
330	1·5375	120·4200	515·07	20645·04	—	—
340	1·4470	121·9575	499·20	21160·11	—	—
350	1·3638	123·4045	484·13	21659·31	—	—
360	1·2861	124·7682	469·42	22143·44	—	—
370	1·2148	126·0543	455·55	22612·86	—	—
380	1·1476	127·2691	441·81	23068·41	—	—
390	1·0853	128·4167	428·71	23510·22	5·0679	—
400	1·0268	129·5020	415·87	23938·93	4·6763	0·0000
410	0·9723	130·5289	403·50	24354·80	4·3212	4·6763
420	0·9226	131·5012	392·09	24758·30	4·0037	8·9975
430	0·8772	132·4237	381·57	25150·39	3·7192	13·0012
440	0·8350	133·3009	371·59	25531·96	3·4610	16·7203
450	0·7964	134·1359	362·37	25903·55	3·2283	20·1812
460	0·7610	134·9323	353·85	26265·92	3·0183	23·4096
470	0·7278	135·6933	345·72	26619·77	2·8261	26·4279
480	0·6973	136·4211	338·21	26965·49	2·6519	29·2540
490	0·6692	137·1185	331·27	27303·70	2·4936	31·9059
500	0·6433	137·7877	324·87	27634·97	2·3495	34·3995
510	0·6183	138·4310	318·45	27959·84	2·2145	36·7490
520	0·5952	139·0493	312·50	28278·29	2·0912	38·9635
530	0·5733	139·6446	306·74	28590·79	1·9766	41·0547
540	0·5526	140·2179	301·14	28897·53	1·8699	43·0312
550	0·5332	140·7705	295·94	29198·67	1·7721	44·9012
560	0·5148	141·3037	290·86	29494·61	1·6805	46·6732
570	0·4977	141·8185	286·15	29785·47	1·5963	48·3538
580	0·4821	142·3162	282·05	30071·62	1·5201	49·9500
590	0·4677	142·7983	278·32	30353·67	1·4498	51·4701
600	0·4539	143·2660	274·58	30631·99	1·3836	52·9200
610	0·4400	143·7199	270·62	30906·57	1·3197	54·3036
620	0·4271	144·1599	266·95	31177·19	1·2604	55·6232
630	0·4142	144·5870	262·99	31444·14	1·2030	56·8836
640	0·4020	145·0012	259·30	31707·13	1·1496	58·0866
650	0·3902	145·4032	255·58	31966·43	1·0987	59·2362
660	0·3787	145·7934	251·81	32222·01	1·0503	60·3349

v	ΔT	T_v	ΔS	S_v	ΔD	D_v
f.s.						
670	0·3678	146·1720	248·28	32473·82	1·0051	61·3852
680	0·3576	146·5399	244·96	32722·10	0·9629	62·3902
690	0·3480	146·8975	241·86	32967·06	0·9235	63·3531
700	0·3385	147·2455	238·67	33208·92	0·8857	64·2766
710	0·3292	147·5840	235·39	33447·59	0·8492	65·1623
720	0·3196	147·9132	231·73	33682·98	0·8131	66·0115
730	0·3105	148·2328	228·25	33914·71	0·7793	66·8246
740	0·3019	148·5434	224·93	34142·96	0·7475	67·6039
750	0·2938	148 8453	221·78	34367·89	0·7176	68·3514
760	0·2853	149·1391	218·23	34589·67	0·6878	69·0690
770	0·2765	149·4243	214·28	34807·90	0·6580	69·7568
780	0·2681	149·7008	210·48	35022·18	0·6300	70·4148
790	0·2602	149·9689	206·83	35232·66	0·6036	71·0447
800	0·2526	150·2291	203·31	35439·49	0·5787	71·6483
810	0·2450	150·4817	199·67	35642·80	0·5544	72·2270
820	0·2371	150·7266	195·64	35842·47	0·5302	72·7814
830	0·2290	150·9638	191·23	36038·11	0·5047	73·3116
840	0·2210	151·1928	186·73	36229·34	0·4824	73·8163
850	0·2133	151·4138	182·39	36416·07	0·4602	74·2986
860	0·2060	151·6271	178·20	36598·46	0·4393	74·7588
870	0·1990	151·8331	174·15	36776·66	0·4195	75·1981
880	0·1924	152·0322	170·24	36950·81	0·4009	75·6176
890	0·1860	152·2245	166·43	37121·05	0·3833	76·0185
900	0·1799	152·4105	162·80	37287·48	0·3666	76·4018
910	0·1741	152·5904	159·26	37450·28	0·3508	76·7684
920	0·1685	152·7644	155·83	37609·54	0·3359	77·1192
930	0·1631	152·9329	152·52	37765·37	0·3218	77·4551
940	0·1580	153·0960	149·31	37917·89	0·3091	77·7769
950	0·1531	153·2540	146·20	38067·20	0·2957	78·0860
960	0·1484	153·4071	143·18	38213·40	0·2836	78·3816
970	0·1439	153·5555	140·26	38356·58	0·2721	78·6652
980	0·1395	153·6993	137·43	38496·84	0·2613	78·9374
990	0·1354	153·8388	134·68	38634·27	0·2509	79·1986
1000	0·1314	153·9742	132·01	38768·95	0·2411	79·4495
1010	0·1272	154·1055	129·08	38900·96	0·2311	79·6906
1020	0·1227	154·2327	125·74	39030·04	0·2207	79·9217
1030	0·1150	154·3554	119·07	39155·78	0·2050	80·1424
1040	0·1046	154·4704	109·28	39274·85	0·1846	80·3474
1050	0·0938	154·5750	98·95	39384·13	0·1640	80·5320
1060	0·0857	154·6688	91·27	39483·08	0·1484	80·6959
1070	0·0800	154·7545	86·02	39574·35	0·1373	80·8443
1080	0·0755	154·8345	81·91	39660·37	0·1283	80·9816
1090	0·0719	154·9100	78·75	39742·28	0·1211	81·1100
1100	0·0688	154·9819	75·97	39821·03	0·1148	81·2311
1110	0·0663	155·0507	73·93	39897·00	0·1097	81·3459
1120	0·0641	155·1170	72·16	39970·93	0·1052	81·4555
1130	0·0624	155·1811	70·83	40043·09	0·1014	81·5607
1140	0·0608	155·2435	69·60	40113·92	0·0979	81·6621
1150	0·0592	155·3043	68·40	40183·52	0·0946	81·7600
1160	0·0577	155·3635	67·23	40251·92	0·0914	81·8546
1170	0·0562	155·4212	66·09	40319·15	0·0883	81·9459
1180	0·0548	155·4775	64·98	40385·24	0·0853	82·0342
1190	0·0535	155·5323	63·89	40450·22	0·0825	82·1196
1200	0·0522	155·5858	62·84	40514·11	0·0798	82·2021
1210	0·0509	155·6379	61·81	40576·95	0·0772	82·2819
1220	0·0496	155·6888	60·80	40638·76	0·0747	82·3591
1230	0·0485	155·7384	59·88	40699·56	0·0724	82·4339

v	ΔT	T_v	ΔS	S_v	ΔD	D_v
f.s.						
1240	0·0473	155·7869	58·92	40759·44	0·0701	82·5673
1250	0·0462	155·8342	58·04	40818·36	0·0680	82·5764
1260	0·0452	155·8805	57·17	40876·40	0·0659	82·6443
1270	0·0442	155·9257	56·38	40933·57	0·0640	82·7102
1280	0·0433	155·9699	55·61	40989·95	0·0621	82·7742
1290	0·0424	156·0132	54·86	41045·56	0·0603	82·8363
1300	0·0415	156·0555	54·12	41100·42	0·0586	82·8967
1310	0·0406	156·0970	53·45	41154·54	0·0570	82·9553
1320	0·0398	156·1377	52·79	41207·99	0·0555	83·0123
1330	0·0391	156·1775	52·15	41260·78	0·0540	83·0677
1340	0·0383	156·2165	51·52	41312·93	0·0525	83·1217
1350	0·0376	156·2548	50·95	41364·45	0·0512	83·1742
1360	0·0369	156·2924	50·39	41415·40	0·0499	83·2254
1370	0·0363	156·3294	49·90	41465·79	0·0487	83·2753
1380	0·0357	156·3656	49·41	41515·69	0·0475	83·3240
1390	0·0351	156·4013	48·94	41565·10	0·0464	83·3715
1400	0·0345	156·4364	48·52	41614·04	0·0453	83·4179
1410	0·0340	156·4709	48·12	41662·56	0·0443	83·4632
1420	0·0335	156·5049	47·72	41710·68	0·0433	83·5075
1430	0·0330	156·5384	47·33	41758·40	0·0424	83·5509
1440	0·0325	156·5714	47·00	41805·73	0·0415	83·5933
1450	0·0321	156·6039	46·68	41852·73	0·0407	83·6348
1460	0·0317	156·6360	46·36	41899·41	0·0398	83·6754
1470	0·0313	156·6677	46·10	41945·77	0·0391	83·7253
1480	0.0309	156·6989	45·80	41991·87	0·0383	83·7544
1490	0·0305	156·7298	45·52	42037·67	0·0376	83·7927
1500	0·0301	156·7602	45·28	42083·19	0·0369	83·8302
1510	0·0298	156·7903	45·10	42128·47	0·0362	83·8671
1520	0·0295	156·8201	44·93	42173·57	0·0356	83·9033
1530	0·0292	156·8496	44·77	42218·50	0·0350	83·9390
1540	0·0289	156·8787	44·57	42263·27	0·0344	83·9740
1550	0·0285	156·9076	44·37	42307·84	0·0339	84·0086
1560	0·0282	156·9361	44·19	42352·21	0·0333	84·0423
1570	0·0279	156·9643	44·01	42396·40	0·0327	84·0756
1580	0·0277	156·9923	43·84	42440·41	0·0322	84·1083
1590	0·0274	157·0199	43·68	42484·25	0·0317	84·1405
1600	0·0271	157·0473	43·47	42527·93	0·0311	84·1721
1610	0·0268	157·0744	43·27	42571·40	0·0306	84·2033
1620	0·0265	157·1012	43·08	42614·67	0·0301	84·2339
1630	0·0262	157·1277	42·90	42657·75	0·0296	84·2640
1640	0·0260	157·1539	42·72	42700·65	0·0291	84·2936
1650	0·0257	157·1799	42·55	42743·37	0·0287	84·3227
1660	0·0255	157·2056	42·39	42785·92	0·0282	84·3513
1670	0·0252	157·2311	42·18	42828·31	0·0277	84·3795
1680	0·0249	157·2563	41·98	42870·49	0·0273	84·4073
1690	0·0247	157·2812	41·78	42912·47	0·0268	84·4345
1700	0·0244	157·3058	41·60	42954·25	0·0264	84·4613
1710	0·0242	157·3302	41·41	42995·85	0·0260	84·4877
1720	0·0239	157·3544	41·23	43037·26	0·0256	84·5137
1730	0·0237	157·3783	41·06	43078·49	0·0252	84·5393
1740	0·0234	157·4019	40·90	43119·55	0·0248	84·5644
1750	0·0232	157·4254	40·69	43160·45	0·0244	84·5892
1760	0·0230	157·4486	40·53	43201·14	0·0240	84·6136
1770	0·0227	157·4715	40·33	43241·67	0·0236	84·6376
1780	0·0225	157·4942	40·19	43282·00	0·0233	84·6612
1790	0·0223	157·5168	40·00	43322·19	0·0229	84·6844
1800	0·0221	157·5390	39·81	43362·19	0·0225	84·7073

GUNNERY TABLE—continued.

v	ΔT	T_v	ΔS	S_v	ΔD	D_v
f.s.						
1810	0·0219	157·5611	39·68	43402·00	0·0222	84·7299
1820	0·0217	157·5830	39·51	43441·68	0·0219	84·7521
1830	0·0214	157·6046	39·34	43481·19	0·0216	84·7740
1840	0·0212	157·6260	39·17	43520·53	0·0212	84·7955
1850	0·0210	157·6473	39·01	43559·70	0·0209	84·8167
1860	0·0209	157·6683	38·90	43598·71	0·0206	84·8376
1870	0·0207	157·6892	38·75	43637·61	0·0203	84·8583
1880	0·0205	157·7098	38·61	43676·36	0·0200	84·8786
1890	0·0203	157·7303	38·46	43714·97	0·0198	84·8986
1900	0·0201	157·7506	38·32	43753·43	0·0195	84·9184
1910	0·0199	157·7707	38·19	43791·75	0·0192	84·9379
1920	0·0197	157·7907	38·01	43829·94	0·0189	84·9571
1930	0·0196	157·8104	37·83	43867·95	0·0186	84·9760
1940	0·0194	157·8300	37·66	43905·78	0·0184	84·9946
1950	0·0192	157·8493	37·48	43943·44	0·0181	85·0130
1960	0·0190	157·8685	37·26	43980·92	0·0178	85·0311
1970	0·0187	157·8875	36·99	44018·18	0·0175	85·0489
1980	0·0185	157·9062	36·73	44055·17	0·0172	85·0664
1990	0·0183	157·9247	36·47	44091·90	0·0169	85·0836
2000	0·0181	157·9430	36·21	44128·37	0,0166	85·1005
2010	0·0178	157·9610	35·95	44164·58	0·0163	85·1171
2020	0·0176	157·9789	35·65	44200·53	0·0160	85·1334
2030	0·0174	157·9965	35·35	44236·18	0·0158	85·1494
2040	0·0171	158·0138	35·06	44271·53	0·0155	85·1652
2050	0·0169	158·0310	34·77	44306·59	0·0152	85·1807
2060	0·0167	158·0479	34·49	44341·36	0·0149	85·1958
2070	0·0165	158·0646	34·21	44375·85	0·0147	85·2108
2080	0·0163	158·0811	33·93	44410·06	0·0144	85·2254
2090	0·0160	158·0974	33·60	44443·99	0·0141	85·2398
2100	0·0158	158·1134	33·34	44477·59	0·0139	85·2539
2110	0·0156	158·1292	33·02	44510·93	0·0136	85·2678
2120	0·0154	158·1448	32·76	44543·95	0·0134	85·2814
2130	0·0152	158·1603	32·50	44576·71	0·0132	85·2948
2140	0·0150	158·1755	32·25	44609·21	0·0129	85·3080
2150	0·0149	158·1905	32·00	44641·46	0·0127	85·3209
2160	0·0147	158·2054	31·75	44673·46	0·0125	85·3336
2170	0·0145	158·2200	31·46	44705·21	0·0123	85·3461
2180	0·0143	158·2345	31·22	44736·67	0·0121	85·3583
2190	0·0141	158·2488	30·98	44767·89	0·0119	85·3704
2200	0·0139	158·2629	30·74	44798·87	0·0117	85·3823
2210	0·0138	158·2768	30·51	44829·61	0·0115	85·3939
2220	0·0136	158·2906	30·23	44860·12	0·0113	85·4054
2230	0·0134	158·3042	30·01	44890·35	0·0111	85·4167
2240	0·0133	158·3176	29·79	44920·36	0·0109	85·4277
2250	0·0131	158·3309	29·53	44950·15	0·0107	85·4386
2260	0·0130	158·3440	29·31	44979·68	0·0105	85·4494
2270	0·0128	158·3569	29·14	45008·99	0·0104	85·4599
2280	0·0127	158·3697	28·98	45038·13	0·0102	85·4701
2290	0·0126	158·3824	28·90	45067·11	0·0101	85·4805
2300	0·0125	158·3950	28·82	45096·01	0·0100	85·4906
2310	0·0125	158·4075	28·84	45124·83	0·0099	85·5006
2320	0·0124	158·4200	28·85	45153·67	0·0098	85·5106
2330	0·0124	158·4324	28·88	45182·52	0·0098	85·5203
2340	0·0123	158·4447	28·91	45211·40	0·0097	85·5301
2350	0·0123	158·4571	28·94	45240·31	0·0096	85·5398
2360	0·0123	158·4694	28·98	45269·25	0·0096	85·5494
2370	0·0122	158·4816	29·02	45298 23	0·0095	85·5589

GUNNERY TABLE—continued.

v	ΔT	T_v	ΔS	S_v	ΔD	D_v
f.s.						
2380	0·0122	158·4938	29·06	45327·25	0·0094	85·5684
2390	0·0122	158·5060	29·10	45356·31	0·0094	85·5778
2400	0·0121	158·5182	29·16	45385·41	0·0093	85·5872
2410	0·0121	158·5303	29·21	45414·57	0·0092	85·5965
2420	0·0121	158·5424	29·27	45443·78	0·0092	85·6057
2430	0·0121	158·5545	29·33	45473·05	0·0091	85·6149
2440	0·0120	158·5665	29·35	45502·38	0·0091	85·6240
2450	0·0120	158·5785	29·37	45531·73	0·0090	85·6331
2460	0·0119	158·5905	29·39	45561·10	0·0089	85·6420
2470	0·0119	158·6024	29·41	45590·49	0·0089	85·6510
2480	0·0119	158·6143	29·44	45619·90	0·0088	85·6598
2490	0·0118	158·6261	29·42	45649·34	0·0087	85·6686
2500	0·0117	158·6379	29·40	45678·76	0·0086	85·6773
2510	0·0117	158·6496	29·39	45708·16	0·0086	85·6859
2520	0·0116	158·6613	29·32	45737·55	0·0085	85·6945
2530	0·0115	158·6729	29·25	45766·87	0·0084	85·7030
2540	0·0115	158·6845	29·13	45796·12	0·0083	85·7114
2550	0·0114	158·6959	29·01	45825·25	0·0082	85·7197
2560	0·0112	158·7073	28·84	45854·26	0·0081	85·7279
2570	0·0111	158·7185	28·67	45883·10	0·0080	85·7359
2580	0·0110	158·7297	28·50	45911·77	0·0079	85·7439
2590	0·0109	158·7407	28·29	45940·27	0·0077	85·7518
2600	0·0108	158·7516	28·12	45968·56	0·0076	85·7595
2610	0·0108	158·7624	28·10	45996·68	0·0076	85·7671
2620	0·0106	158·7731	27·70	46024·78	0·0074	85·7747
2630	0·0105	158·7837	27·54	46052·48	0·0073	85·7821
2640	0·0103	158·7941	27·33	46080·02	0·0072	85·7894
2650	0·0102	158·8045	27·18	46107·35	0·0071	85·7966
2660	0·0101	158·8147	26·97	46134·53	0·0070	85·8038
2670	0·0100	158·8248	26·77	46161·50	0·0069	85·8108
2680	0·0099	158·8348	26·62	46188·27	0·0068	85·8177
2690	0·0098	158·8447	26·43	46214·89	0·0067	85·8245
2700	0·0097	158·8545	26·23	46241·32	0·0066	85·8312
2710	0·0096	158·8642	26·09	46267·55	0·0065	85·8378
2720	0·0095	158·8738	25·90	46293·64	0·0064	85·8443
2730	0·0094	158·8833	25·71	46319·54	0·0063	85·8507
2740	0·0093	158·8927	25·52	46345·25	0·0062	85·8571
2750	0·0092	158·9020	25·34	46370·77	0·0062	85·8633
2760	0·0091	158·9112	25·15	46396·11	0·0061	85·8695
2770	0·0090	158·9203	24·97	46421·26	0·0060	85·8755
2780	0·0089	158·9293	24·79	46446·23	0·0059	85·8815
2790	0·0088	158·9382	24·62	46471·02	0·0058	85·8874
2800	0·0087	158·9470	24·32	46495·64	0·0057	85·8932

II.

In applying the Gunnery Table, the *data* and *quæsita* being,—

d, the diameter of the projectile in inches;
W, the weight of the projectile in lbs.; and therefore $\frac{W}{d^2}$ the sectional density;
V, any initial velocity in *feet* per *second*;
v, " final " " "
t, the corresponding time of flight in *seconds*;
s, the distance gone in *feet*;
δ, the deviation of direction in *degrees*;

and T, S, D the corresponding reduced time, distance, and deviation; it is required when the data are any three of the quantities $\frac{W}{d^2}$, V, v, T, S, D, to determine the remaining three.

One of the data must, however, be V or v, otherwise a tentative process must be adopted.

These applications will be illustrated by the following practical examples. Similar examples will be found in Bashforth's "*Motion of Projectiles*;" Sladen's "*Principles of Gunnery*;" the "*Handbook for Field Service*; Lieut.-Col. W. H. Noble's "*Useful Tables*" (where also the Gunnery Table will be found printed); "*Trajectories of the 9-pr., 13-pr., and 16-pr. M.L.R. guns*"; by Lieut. P. A. MacMahon, R.A., in the R. A. I. "Proceedings," Vol. XI.; and Major W. McClintock's "*Problems in Gunnery*," in the R. A. Institution "Proceedings," Vol. XII., No. 6.

An unlimited supply of numerical examples can also be obtained from the Range Tables prepared in the office of the Director of Artillery.

(1) Find how many seconds it will take for the velocity of the projectile fired from the 3-inch 13-pr. M.L.R. gun to fall from 1550 to 940.

Here V and v are given, to find t; and $d = 3$, $W = 13$, $V = 1550$, $v = 940$.

From the gunnery table—

$$T_V = 156{\cdot}9076,$$

$$T_v = 153{\cdot}0960,$$

$$T_V^v = \quad 3{\cdot}8116,$$

$$t = \frac{W}{d^2}\, T_V^v = 5{\cdot}5.$$

(2) At Spezzia, in November, 1882, the 17-inch 100-ton B.L. gun fired a projectile of 2005 lb. with a charge of 606·8 lb. of powder, and a consequent muzzle velocity of 1600. With an elevation of 11°½ the time of flight was observed to be 18·4 seconds; find the remaining velocity.

Here V and t are given, to find v; and $d = 17$, $W = 2005$; $V = 1600$, $t = 18{\cdot}4$.

From the table—

$$T_V = 157 \cdot 0473\,,$$

and

$$T_V^v = \frac{d^2}{W} t$$

$$= \quad 2 \cdot 6522\,,$$

$$\therefore \quad T_v = 154 \cdot 3951\,.$$

But

$$T_{1030} = 154 \cdot 3554\,,$$

$$\Delta T = \quad \cdot 1150\,,$$

$$\text{diff. for} \quad v = \quad \cdot 0397\,;$$

$$\therefore \quad v = 1030 + \frac{397}{115} = 1033 \cdot 45\,.$$

(3) A 6-inch shell of 80 lb. was found to have penetrated 6 feet of earth, implying a striking velocity of 1200. The time of flight was observed to be 3·5 seconds; find the muzzle velocity.

Here v and t are given, to find V; and $d = 6$, $W = 80$, $v = 1200$, $t = 3 \cdot 5$.

From the table—

$$T_v = 155 \cdot 5858\,,$$

$$T_V^v = \frac{d^2}{W} t$$

$$= \quad 1 \cdot 5750\,,$$

$$\therefore \quad T_V = 157 \cdot 1608\,.$$

But

$$T_{1640} = 157 \cdot 1539\,,$$

$$\Delta T = \quad \cdot 0260\,,$$

$$\text{diff. for} \quad V = \quad \cdot 0069\,;$$

$$\therefore \quad V = 1640 + \frac{69}{26} = 1642 \cdot 7\,.$$

(4) Find the range of the projectile in example (2).

Here we are given V and v to find s; where $d = 17$, $W = 2005$, $V = 1600$, $v = 1033 \cdot 45$.

From the table—

$$S_V = 42527 \cdot 93\,,$$

and

$$S_{1030} = 39155 \cdot 78\,,$$

$$\Delta S = \quad 119 \cdot 07\,;$$

$$\begin{aligned} \text{diff. for } 3 \cdot 45 = \quad & 35 \cdot 721 \\ & \;\; 4 \cdot 7628 \\ & \;\;\; \cdot 59535 \\ = \quad & 41 \cdot 07915\,, \\ = \quad & 41 \cdot 08\,, \text{ (say)}. \end{aligned}$$

$$\therefore \quad S_v = 39196 \cdot 86\,,$$

$$S_V^v = \quad 3331 \cdot 07\,,$$

and

$$s = \frac{W}{d^2} S_V^v$$

$$= 23110\,.$$

The range is therefore 7703 yards.

(5) Find the number of inches of armour a 6-inch steel shell of 80 lb., fired from the B. L. gun with a charge of 42 lb. of powder, giving a muzzle velocity of 1900, will pierce at 1000 yards. Find also the time of flight.

Here V and s are given, to find v; and $d = 6$, $W = 80$, $V = 1900$, $s = 3000$.

From the table—

$$S_V = 43753{\cdot}43\,,$$

and

$$S_V^v = \frac{d^2}{W} s$$

$$= 1350$$

$$S_v = 42403{\cdot}43\,.$$

But

$$S_{1570} = 42396{\cdot}40\,,$$

$$\Delta S = 44{\cdot}01\,,$$

$$\text{diff. for } v = 7{\cdot}03$$

$$v = 1570 + \frac{70{\cdot}3}{44{\cdot}01}$$

$$= 1571{\cdot}5\,.$$

Using Captain Orde Browne's formula that "the penetration in calibres is equal to the number of thousands in the velocity;" then the penetration in inches will be—

$$\frac{6v}{1000} = 9{\cdot}429\,.$$

The shell ought therefore to pierce 9·4 inches of armour.

Also, from the table—

$$T_V = 157{\cdot}7506\,,$$

$$T_v = 156{\cdot}9685\,,$$

$$T_V^v = {\cdot}7821\,,$$

$$t = \frac{W}{d^2} T_V^v,$$

$$= 1{\cdot}738\,.$$

(6) Find the muzzle velocity of the 3-inch 13-pr., by firing through screens, using the Boulengé chronograph.

The screens are 50 yards apart, and the first screen is 30 yards from the muzzle.

The interval of time between cutting the screens, as recorded by the chronograph, being 0·096 seconds, the mean velocity of the projectile between the screens $= \dfrac{150}{{\cdot}096} = 1562{\cdot}5$.

Assuming this velocity to be the velocity at a point midway between the screens, the distance of this point from the muzzle is 55 yards or 165 feet.

The data are therefore v and s, to find V; where $d = 3$, $W = 13$, $v = 1562{\cdot}5$, $s = 165$.

From the table—

$$S_{1560} = 42352{\cdot}21\,,$$
$$\Delta S = \quad 44{\cdot}19\,;$$
$$\text{diff. for} \quad 2{\cdot}5 = \quad 8{\cdot}838$$
$$2{\cdot}2095\,;$$
$$\therefore \quad S_v = 42363{\cdot}2575\,,$$
$$= 42363{\cdot}26\,,\ \text{say}\,;$$

and
$$S_V^v = \frac{d^2}{W}s$$
$$= \quad 114{\cdot}23\,,$$
$$S_V = 42477{\cdot}49\,.$$

But
$$S_{1580} = 42440{\cdot}41\,,$$
$$\Delta S = \quad 43{\cdot}84\,;$$
$$\text{diff. for} \quad V = \quad 37{\cdot}08\,,$$
$$\therefore \quad V = 1580 + \frac{370{\cdot}8}{43{\cdot}84} = 1588{\cdot}5\,.$$

(7) Determine the remaining velocity and the time of flight of the Martini-Henry bullet, of 480 grains and ·45 calibre, for every 200 yards up to 1000 yards, the muzzle velocity being 1315.

I. V and s are given, to find v; where $d = {\cdot}45$, $W = 480 \div 7000$, $V = 1315$, and $s = 600$.

Denote the velocity at the end of 200, 400, ..., 1000 yards by $v_2, v_4, \ldots . \, v_{10}$ respectively.

From the table—

$$S_V = 41181{\cdot}265\,,$$

and
$$S_V^{v_2} = \frac{d^2}{W}s = \frac{({\cdot}45)^2 \times 7000}{480} \times 600\,,$$
$$= \quad 1771{\cdot}875\,,$$
$$S_{v_2} = 39409{\cdot}39\,,\ v_2 = 1052{\cdot}55\,.$$

Again
$$S_{v_2}^{v_4} = \quad 1771{\cdot}875\,,$$
$$S_{v_4} = 37637{\cdot}515\,,\ v_4 = 921{\cdot}8\,.$$
$$S_{v_4}^{v_6} = \quad 1771{\cdot}875$$
$$S_{v_6} = 35865{\cdot}64\,,\ v_6 = 821.$$
$$S_{v_6}^{v_8} = \quad 1771{\cdot}875\,,$$
$$S_{v_8} = 34093{\cdot}765\,,\ v_8 = 738\,.$$
$$S_{v_8}^{v_{10}} = \quad 1771{\cdot}875\,,$$
$$S_{v_{10}} = 32321{\cdot}89\,,\ v_{10} = 664\,.$$

II. Denote the times of flight over 200, 400, ..., 1000 yards by $t_2, t_4, \ldots t_{10}$; then V and v are given, to find t; and—

$$T_V = 156 \cdot 1173,$$
$$T_{v_2} = 154 \cdot 59891,$$
$$T_V^{v_2} = \quad 1 \cdot 51839,$$
$$t_2 = \frac{W}{d^2} T_V^{v_2} = \cdot 5142.$$

$$T_{v_4} = 152 \cdot 79473,$$
$$\therefore \; T_V^{v_4} = \quad 3 \cdot 32257,$$
$$t_4 = \frac{W}{d^2} T_V^{v_4} = 1 \cdot 1251.$$

$$T_{v_6} = 150 \cdot 7503,$$
$$T_V^{v_6} = \quad 5 \cdot 3670,$$
$$t_6 = \quad 1 \cdot 8174.$$

$$T_{v_8} = 148 \cdot 4812,$$
$$T_V^{v_8} = \quad 7 \cdot 6361.$$
$$\therefore \; t_8 = \quad 2 \cdot 58577.$$
$$T_{v_{10}} = 145 \cdot 9449,$$
$$T_V^{v_{10}} = \quad 10 \cdot 1724,$$
$$t_{10} = \quad 3 \cdot 4446.$$

Knowing these quantities it is possible to plot out a series of points on the trajectory at every 200 yards in a range of 1000 yards; for denoting the heights, in feet, of the points by h_2, h_4, h_6, h_8; and the time of flight by $T = t_{10}$; then, from the formula,—

$$h_2 = \tfrac{1}{2} g t_2 (T - t_2);$$

$$\log \tfrac{1}{2} g = 1 \cdot 2067018, \qquad T = \; 3 \cdot 4446;$$
$$\log t_2 = \bar{1} \cdot 7111321, \qquad t_2 = \; \cdot 5142;$$
$$\log (T - t_2) = \cdot 4669269, \qquad T - t_2 = \; 2 \cdot 9304;$$
$$\log h_2 = 1 \cdot 3847608, \qquad h_2 = 24 \cdot 2527.$$

Similarly

$$h_4 = \tfrac{1}{2} g t_4 (T - t_4) = 42 \cdot 0037;$$
$$h_6 = \tfrac{1}{2} g t_6 (T - t_6) = 47 \cdot 5985;$$
$$h_8 = \tfrac{1}{2} g t_8 (T - t_8) = 35 \cdot 7437.$$

If H denote the height, in feet, of the vertex of the trajectory, then from the formula,—

$$H = \tfrac{1}{8} g T^2, \quad T = 3 \cdot 4446,$$

and therefore

$$H = 47 \cdot 744.$$

A similar example is worked out in Sladen's "*Principles of Gunnery*," p. 67.

(8) Find the elevation required with the Martini-Henry rifle at 1000 yards.

Here V and v are given, to find D, and then a, with the data of the preceding example.

Denoting the velocity at the vertex of the trajectory by v_0, then,—

$$t_V^{v_0} = \tfrac{1}{2} t_V^{v_{10}};$$

$$\therefore\ T_V^{v_0} = \tfrac{1}{2} T_V^{v_{10}},$$

$$= 5{\cdot}0862;$$

and $$T_V = 156{\cdot}1173,$$

$$\therefore\ T_{v_0} = 151{\cdot}0311.$$

But $$T_{830} = 150{\cdot}9638,$$

$$\Delta T = {\cdot}2290,$$

$$\text{diff. for } v_0 = {\cdot}0673;$$

$$\therefore\ v_0 = 830 + \frac{{\cdot}673}{{\cdot}229} = 833.$$

From the table,—

$$D_V = 82{\cdot}9838,$$

$$D_{v_0} = 73{\cdot}46301,$$

$$D_V^{v_0} = 9{\cdot}5208,$$

and $$a = \frac{W}{d^2} D_V^{v_0}$$

$$= 3{\cdot}2239;$$

the angle of departure is therefore 3° 13′.

In the manufacture at Enfield an elevation of 3° 6′ is given for 1000 yards range; the jump is therefore 7′.

(9) The 17-inch 100-ton B. L. gun was fired, at Spezzia, with a 2005 lb. projectile, at an elevation of 11° 50′, with a charge of 771·6 lb. of powder, giving a muzzle velocity of 1833. Find the velocity at the vertex of the trajectory, and then find the time of flight, the remaining velocity, the range, the angle of descent, &c.

Here V and a are given, to find in the first place v_0, the velocity at vertex: and $d = 17$, $W = 2005$, $V = 1833$, $a = 11{\cdot}83$.

From the table,—

$$D_V = 84{\cdot}7740,$$
$$\phantom{D_V = 84{\cdot}7}{\cdot}00648$$
$$= 84{\cdot}78048;$$

and

$$D_V^{v_0} = \frac{d^2}{W} a,$$
$$= 1{\cdot}70517;$$
$$\therefore \quad D_{v_0} = 83{\cdot}07531.$$

But

$$D_{1330} = 83{\cdot}06770,$$
$$\Delta D = 0{\cdot}0540,$$
$$\text{diff. for } v_0 = 0{\cdot}00761;$$
$$\therefore \quad v_0 = 1330 + \frac{{\cdot}0761}{{\cdot}0540} = 1331{\cdot}4;$$

the velocity at the vertex.

But

$$T_V = 157{\cdot}6046$$
$$\phantom{T_V = 157{\cdot}6}{\cdot}00642$$
$$= 157{\cdot}61102;$$
$$T_{v_0} = 156{\cdot}1775$$
$$\phantom{T_{v_0} = 156{\cdot}1}{\cdot}00391$$
$$\phantom{T_{v_0} = 156{\cdot}1}{\cdot}001564$$
$$= 156{\cdot}182974;$$
$$T_V^{v_0} = 1{\cdot}428046;$$
$$t_V^{v_0} = \frac{W}{d^2} T_V^{v_0}$$
$$= 9{\cdot}9073.$$

If v denote the terminal velocity, and T the time of flight; then,—

$$T = t_V^v = 2 t_V^{v_0}$$
$$= 19{\cdot}8146.$$

Also

$$T_V^v = 2 T_V^{v_0}$$
$$= 2{\cdot}856092;$$

and

$$T_V = 157{\cdot}61102;$$
$$\therefore \quad T_v = 154{\cdot}754928.$$

But
$$T_{1070} = 154{\cdot}7545\,,$$
$$\Delta T = \quad {\cdot}0800\,;$$
$$\text{diff. for } v = \quad {\cdot}000428\,;$$
$$\therefore\; v = 1070 + \frac{{\cdot}00428}{{\cdot}08} = 1070{\cdot}0535\,;$$
the remaining velocity at the end of the range.

Again, from the table,—
$$S_V = 43481{\cdot}19$$
$$11{\cdot}802$$
$$= 43492{\cdot}992\,;$$
$$S_v = 39574{\cdot}35$$
$${\cdot}46021$$
$$= 39574{\cdot}81021\,;$$
$$\therefore\; S_V^v = 3918{\cdot}18179\,;$$
and
$$s = \frac{W}{d^2}\,S_V^v$$
$$= 27183{\cdot}23\,;$$
and therefore the range is 9061 yards, or 5 miles 261 yards.

Again, let β denote the angle of descent in degrees; then from the table,—
$$D_V = 84{\cdot}78048\,,$$
$$D_v = 80{\cdot}8443$$
$${\cdot}0007346$$
$$= 80{\cdot}8450346\,;$$
$$\therefore\; D_V^v = 3{\cdot}9354454\,;$$
and
$$\alpha + \beta = \frac{W}{d^2}\,D_V^v$$
$$= 27{\cdot}303\,.$$
But
$$\alpha = 11{\cdot}833\,,$$
$$\therefore\; \beta = 15{\cdot}470\,,$$
and the angle of descent is $15^\circ\,28'$. The height of the vertex in feet,—
$$H = 4T^2 = 1570{\cdot}47\,.$$

(10) In attacking a place with curved fire it was required to drop shell into the place with an angle of descent of 12°, and a terminal velocity of 600, using the 8-inch howitzer and a projectile of 180 lb. Find the requisite position of the battery and the requisite elevation, and charge of powder.

Here v and β are given, to determine V, s and α; and $d=8$, $W=180$, $v=600$, $\beta=12$.

Let v_0 denote the velocity at the vertex of the trajectory; then,—

$$D^v_{v_0} = \frac{d^2}{W}\beta$$
$$= 4 \cdot 2667;$$

and, from the table,—

$$D_v = 52 \cdot 9200,$$
$$\therefore \quad D_{v_0} = 57 \cdot 1867.$$

But

$$D_{630} = 56 \cdot 8836,$$
$$\Delta D = 1 \cdot 2030,$$
$$\text{diff. for } v_0 = \cdot 3031,$$
$$\therefore \quad v_0 = 630 + \frac{3 \cdot 031}{1 \cdot 203}$$
$$= 632 \cdot 5.$$
$$T_{630} = 144 \cdot 5870$$
$$\text{diff. for } 2 \cdot 5 = \cdot 08284$$
$$\cdot 02071$$
$$\therefore \quad T_{v_0} = 144 \cdot 69055;$$

and

$$T_v = 143 \cdot 2660,$$
$$T^v_{v_0} = 1 \cdot 42455.$$

Assuming that the vertex is the point of half time of flight, then,—

$$T^v_V = 2T^v_{v_0}$$
$$= 2 \cdot 8491;$$

and

$$T_v = 143 \cdot 2660,$$
$$\therefore \quad T_V = 146 \cdot 1151.$$

But

$$T_{660} = 145 \cdot 7934,$$
$$\Delta T = \cdot 3787,$$
$$\text{diff. for } V = \cdot 3217,$$
$$\therefore \quad V = 660 + \frac{3 \cdot 2170}{\cdot 3787}$$
$$= 668 \cdot 4.$$

Again,
$$S_{660} = 32222 \cdot 01\,,$$
$$\text{diff. for } 8 \cdot 4 = \quad 201 \cdot 448$$
$$10 \cdot 0724\,.$$
$$\therefore \quad S_V = 32433 \cdot 5304\,,$$
and
$$S_v = 30631 \cdot 99\,,$$
$$\therefore \quad S_V^v = \quad 1801 \cdot 54\,;$$
and
$$s = \frac{W}{d^2} S_V^v$$
$$= 5066 \cdot 83\,;$$
therefore the range must be made 1689 yards.

Again, using proportional parts,—
$$D_V = 61 \cdot 2172\,,$$
$$D_{v_0} = 57 \cdot 1844\,;$$
$$\therefore \quad D_V^{v_0} = \quad 4 \cdot 0328$$
and
$$\alpha = \frac{W}{d^2} D_V^{v_0}$$
$$= 11 \cdot 34\,.$$

The battery must therefore be established at a distance of 1689 yards from the place to be attacked; the elevation must be 11° 20′, and the charge of powder must be such as to give a muzzle velocity of 668·4.

(11) Find the elevation required for a range of 2000 yards with the 16-pr. M.L.R. gun, the muzzle velocity being 1355. Find also the time of flight and the angle of descent.

Here V and s are given, to determine α, and also t and β; this is the most usual form of the problem in gunnery presented for solution.

Put $d = 3 \cdot 6$, $W = 16$, $V = 1355$, $s = 6000$; then v, the final velocity, must first be determined.

From the table,—
$$S_V = 41389 \cdot 925\,,$$
$$S_V^v = \frac{d^2}{W} s$$
$$= 4860$$
$$S_v = 36529 \cdot 925\,.$$

From the table,

$$S_{850} = 36416 \cdot 07,$$
$$\Delta S = \quad 182 \cdot 39,$$
$$\text{diff. for } v = \quad 113 \cdot 855;$$
$$\therefore \quad v = 850 + \frac{1138 \cdot 55}{182 \cdot 39}$$
$$= 856.$$

Again,

$$T_V = 156 \cdot 2736,$$
$$T_v = 151 \cdot 5418;$$
$$\therefore \quad T_V^v = \quad 4 \cdot 7318.$$

Therefore, if v_0 denote the velocity at the vertex,—

$$T_V^{v_0} = \tfrac{1}{2} T_V^v$$
$$= \quad 2 \cdot 3659,$$

and

$$Tv_0 = 153 \cdot 9077.$$

But

$$T_{990} = 153 \cdot 8388,$$
$$\Delta T = \quad \cdot 1354,$$
$$\text{diff. for } v_0 = \quad \cdot 0689;$$
$$\therefore \quad v_0 = 990 + \frac{\cdot 689}{\cdot 1354}$$
$$= 995.$$

From the table,—

$$D_V = 83 \cdot 1998,$$
$$Dv_0 = 79 \cdot 3241,$$
$$\therefore \quad D_V^{v_0} = \quad 3 \cdot 8757;$$

and

$$a = \frac{W}{d^2} D_V^{v_0}$$
$$= 4 \cdot 7848,$$

and the angle of departure must therefore be 4° 47′.

Again,

$$T_V^v = 4 \cdot 7318,$$
$$\therefore \quad t = \frac{W}{d^2} T_V^v$$
$$= 5 \cdot 8418,$$

the time of flight in seconds.

If β denote the angle of descent in degrees, then since,—

$$Dv_0 = 79{\cdot}3241\,,$$

$$Dv = 74{\cdot}5747\,,$$

$$\therefore\ D^v_{v_0} = 4{\cdot}7494\,,$$

and
$$\beta = \frac{W}{d^2} D^v_{v_0}$$

$$= 5{\cdot}863\,;$$

and the angle of descent is therefore 5° 52′.

(12) Find the requisite angle of elevation in Example (5).
Here $d = 6$, $W = 80$, $V = 1900$, and $s = 3000$; to find α.
We have found,—

$$T^v_V = \cdot 7821\,;$$

$$\therefore\ T^{v_0}_V = \cdot 39105\,,$$

v_0 denoting the velocity at the vertex; and

$$T_V = 157{\cdot}7506\,,$$

$$\therefore\ Tv_0 = 157{\cdot}35955\,;$$

$$\therefore\ v_0 = 1720\,.$$

Again,
$$D_V = 84{\cdot}9184\,,$$

$$Dv_0 = 84{\cdot}5137\,,$$

$$D^{v_0}_V = \cdot 4047\,,$$

and
$$\alpha = \frac{W}{d^2} D^{v_0}_V = \cdot 899\,;$$

the angle of elevation is therefore 54′.

(13) The 12·5 inch R. M. L. gun, firing a projectile of 820 lb. with a charge of 210 lb. of powder, has a range of 2900 yards, and a time of flight of 6·25 seconds. Find the muzzle velocity.

Here t and s are given, to find V and v; and a tentative process must therefore be adopted.

Since $d = 12{\cdot}5$, $W = 820$, $t = 6{\cdot}25$, $s = 8700$;

$$\therefore\ T^v_V = \frac{d^2}{W} t$$

$$= 1{\cdot}1909\,;$$

and
$$S^v_V = \frac{d^2}{W} s$$

$$= 1657{\cdot}78\,.$$

By a tentative process it will be found that $V = 1575$, $v = 1240$, satisfy these conditions.

(14) Find the muzzle velocity of the 12·5 inch R. M. L. gun, firing a projectile of 820 lb., when an elevation of 3° 54′ gives a range of 2900 yards; and increasing the elevation 10′ gives an additional range of 117 yards 2 feet.

Here s and δ are given, to determine V and v; the tentative process must therefore be adopted.

As in the last example,—

$$S_V^v = 1657{\cdot}78;$$

also if $R = 2900$ and $\Delta\alpha = \frac{1}{6}$, then $\Delta R = 117\frac{2}{3}$ (*vide* § 10)

and therefore
$$\tan\beta = \frac{\pi}{180}\,\frac{R\Delta\alpha}{\Delta R} = {\cdot}071692$$
$$= \tan 4^\circ\, 6';$$

therefore
$$\beta = 4{\cdot}1;$$

and
$$\delta = \alpha + \beta$$
$$= 3{\cdot}9 + 4{\cdot}1 = 8;$$

therefore
$$D_V^v = \frac{d^2}{W}\delta$$
$$= 1{\cdot}5244.$$

By a tentative process it will be found, as before, that $V = 1575$, $v = 1240$ satisfy these conditions.

NOTES

ON THE

PURCHASING, DISTRIBUTION, AND CARE OF ROYAL ARTILLERY REMOUNTS.

BY

COLONEL F. G. RAVENHILL, R.A.,

Inspector and Purchaser of R.A. Horses.

When horses are being purchased for the Royal Artillery, para. 799 of the Allowance Regulations directs that the fitness of the horses selected, as regards strength, action and appearance (which includes height), is to be determined by the Purchasing Officer, and that their soundness (including age) is to be decided by the Army Veterinary Surgeon in attendance. Although the duties of these two officers are thus quite distinct, each is bound to work with and assist the other.

Fitness.

Soundness.

The age at which horses are to be taken is laid down in para. 798 Allowance Regulations.

Age.

When remounts are required, one of the first steps is for the Purchasing Officer to ascertain who are the most respectable and substantial dealers. The preference should be given to those whose ordinary trade is in horses of the class required for the service, and then no difficulty will be experienced in getting rid of "misfits." If any others are employed, they will take care, when attending fairs and sales, to secure all the best young stock for their own purposes, and will endeavour to pass on their "misfits" to the Government.

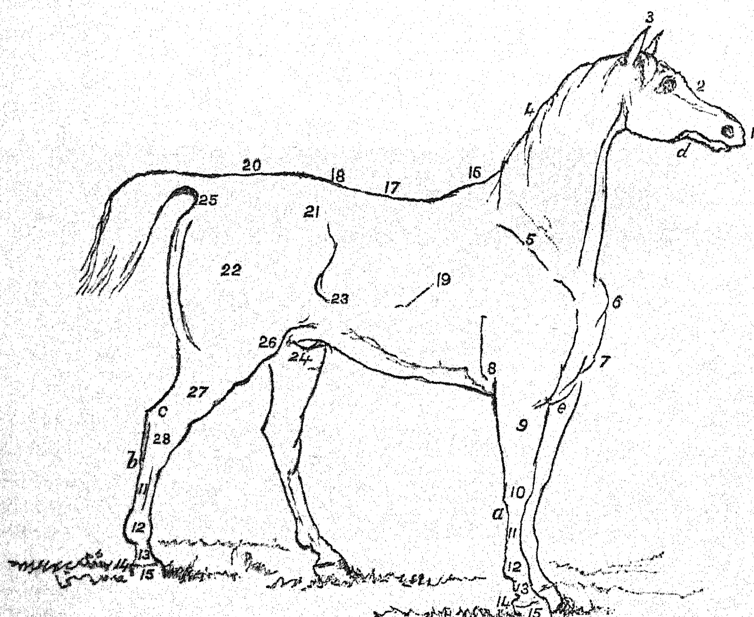
Dealers.

Under ordinary circumstances all horses purchased for the Government should be kept one month on trial—*vide* para. 802 Allowance Regulations. This probation can easily be carried out at home (where the horses are procured through agents or dealers), and it should be rigidly enforced, though there may be some difficulty in doing so abroad. The conditions should be explained beforehand in writing to the dealers, who ought also to be furnished with a written statement of the age at which horses will be taken, and of the prices and travelling allowances which will be paid for them. If one dealer objects to the Government terms, others will easily be found ready to comply with them.

Probation.

Proportion of riding and draught horses. It must be borne in mind that of the total number of horses required, at least half should have shoulders, action, and breeding suitable for riding; and of these one-fifth should have sufficient appearance for carrying officers. The other half must be strong enough for draught purposes, and a proportion should be fit for the quicker work of Horse Artillery.

Height. The height at which horses are taken at present is between 15–2 and 16 hands, though specially good, muscular horses and promising young animals are passed lower. In measuring a horse the measuring standard must be held upright, with its foot on a level with the heel of the horse's foot, and the horizontal bar (which ought to contain a spirit level) should just touch the arched bones of the withers (16) at its highest point. Care must be taken that the horse is standing fairly on level ground and not extended; allowance should be made for exceptionally thick shoes or unusually long feet, constantly an allowance of half-inch or even an inch being made for shoes. It must be remembered that a horse over height, when about to be measured, is very often placed in a hole, while an undersized animal is sometimes found standing on a sloping stone.



Colour. Only bays, browns, chestnuts, or blacks of hardy colour may be taken. When the colour of a horse is doubtful, the shade of the skin round the eye and nose or under the flanks and ends will determine it.

Examination of mouth and eyes. Every horse about to be examined should be taken under a shed, archway, or to the stable door, where the light is suitable. The Veterinary Surgeon first examines the mouth in order to determine

Measuring and examination from near side. Cannon bone. Arms and thighs.

the animal's age, and at the same time he sees that there is no defect in the jaw or teeth. The eyes should then be carefully inspected, and if they are found to be sound, the horse may be led out for examination by the Purchasing Officer, care being taken that no "gingering" is practised. Any good looking five or six year old horse submitted at Troop price, should be treated with suspicion. The Purchasing Officer will measure the horse, note the colour, and observe from his near side how he stands all round on his feet and legs; whether he looks small or tied in below and at the back of the knee. Every Troop horse ought, if possible, to measure not much less than eight inches round the leg close under the knee (*a*), and the bigger and flatter he is here the better; for it is at this point that strength is specially required. The cannon bone (11) should be short and, together with the tendons, distinctly defined; the arms (9) and thighs (27) long and muscular, and the joints not small, but clean and well developed.

Knees. Elbows. Hind legs. Hocks. Pasterns. Fetlocks.

The knees (10) should not be back like those of a calf, nor too much bent over like those of an old cab horse—though of the two evils it is preferable that a horse should stand a little over at the knee rather than back; the elbows (8) should be free; the hind legs must be well placed under the body; the hocks (28) not too straight, yet not sickled or bent; they should be clean, well cut and free from any enlargement inside or out, or from any tendency to curb (*b*) or thoroughpin (*c*); the pasterns (13) must neither be too short and upright, nor too long and sloping; the fetlocks (12) should not show signs of work, too much play either in these joints or in the pasterns produces overshooting, which is a decided weakness. There are occasional swellings on these parts, especially in young stock, arising from sickness, debility, or contusions, which are sometimes mistaken for unsoundness.

Feet.

The feet (15) should be of the same size, round in shape at the soles, with good open heels, not small, contracted or flat; the hoofs should stand as nearly as possible at an angle of 50°, and they must not be brittle, blocky or ringy.

Head.

In considering the shape of the head, it is important to note the position of the eye which should not be too low down, too far forward, or too small; the last named defect is called "pig-eyed." The forehead should be broad and the countenance kind. Long, big ears—provided they are not lopped or drooping—are preferable to such as are small, curved or pointed, though these latter are no doubt prettier. The head should be well set on to the neck at an angle not too oblique or acute, and there should be sufficient room under the jowl. The nostrils should be large and open. The lips not drooping or relaxed. The jaws and teeth evenly placed above one another.

Neck. Shoulders.

The neck should be convex and not concave, which latter is a structural defect indicating weakness and is called "ewe-neck." It should be well set into the shoulders, and these should be clearly defined (5), sloping well back from the points (6) to the withers (16).

The points of the shoulders ought not to be heavy. Fine high withers are a great attraction, and enable the saddle to retain its proper position. It is true that horses with thick or flat withers, or short upright shoulders may be suitable for draught, provided they have good action.

Barrel.

The barrel (19) should be deep and arched behind the elbows (8), thus affording space for the development of all vital organs. Every Troop horse should girth (19) as much over 70 inches as may be procurable.

Back and loins.

A long or hollow back (17) should be avoided. A "roach back"—though ugly—is strong. The loins (18) should be as broad and deep as possible.

Tail.

The tail (25) should be set on high enough to be symmetrical. Fine hair in the mane and tail shews breeding. The greater the length from nose to withers and from hip to croup the better. Care should be taken that the withers, shoulders, back and chine are free from material blemishes.

Examination of Chest and forelegs, &c., from front.

While the horse remains standing, the position of the Purchasing Officer may be changed from the near side to the front, so as to note how he looks from this point of view, and to see how he stands, whether he has sufficient breadth of chest. There should be no blemishes about the knees, no enlargements or scars from brushing inside the fetlocks, no marks from speedy-cutting under the knees, and the situation of splents, if there be any, should be particularly noticed.

Shank bone.

The shank bone (11) should be straight and square under the body, not bandied or twisted, but supporting properly the weight of the body. The toes should neither be in nor out, a tendency to the latter being preferable to the former. One foot turned out or in is unsatisfactory, because it indicates uneven action with an uneven bearing of the weight of the body either at rest or in motion.

Examination of Off side and Rear.

The off side must next be examined in detail in the manner already specified for the near side. The Purchaser should then walk round to the rear of the horse, and notice if the hocks are very much in or bowed out—of the two the former is preferable. A horse ought to be broad across the hips, and these must be even and level, the fork should not be too much split up.

Walking.

The horse must now be led off at a walk; the purchaser should keep behind him and note as he goes from him if he turns his toes out or in, or whether there is too much play outwards or inwards in the hocks. If he crosses his hind or fore feet or legs he should be rejected. As the horse turns, he should be narrowly watched, and as he walks past it should be seen that he puts his feet down even and fair. The action of his fetlocks (12) and pasterns (13) must also be noted. If there be decided knuckling or overshooting here, he must not be taken,

The walk should be free, the stride long and clear, the hocks not bent, no dragging or catching of the hind or fore toes along the ground, no "forging" from over-reaching. When the toes are out, the elbows are in, and the latter being tied, the fore action is often cramped and contracted.

The animal can now be trotted, and, as he goes from you it must be noted if he crosses his fore or hind legs, which is dangerous; if he dishes or turns one or both feet in or out, it is objectionable. Should he roll in his stride, this may denote damage in the loins or hocks; and the attention of the Veterinary Surgeon, who is responsible for soundness, would naturally be called to these points. If there is any catching in the action of the hind legs, he should be run sharply backwards to ascertain that there is no paralysis, as the horse passes it should be seen that he has good knee and hock action. **Trotting.**

Speedy-cutting arises from faulty confirmation of the fore legs, and also from a peculiar kind of high action in front. It is the act of striking one fore leg just below the knee with the inner quarter of the other fore foot, a most acutely painful and dangerous thing, for which a horse should be at once rejected. On most of these subjects, however, the Veterinary Surgeon, who is also responsible, must be consulted. **Speedy cutting.**

At this period the horse will be more particularly taken over by the attending Veterinary Officer, who will proceed to make a thorough professional examination of him. **Veterinary examination.**

Although a horse is a good coloured, well topped, good going, taking animal, yet, if he have one decidedly weak or bad point, he must be refused; but here the Veterinary Officer's opinion will be most valuable, as many horses may be quite serviceable, though not *absolutely sound* and may "in times of need" be fully equal to the requirements of a campaign, and do much hard work. **Reject for any one weak or bad point.**

Purchasing horses is laborious work, and by the time that twenty-five or thirty have been examined, passed, and registered, the officers employed will have exhausted much power both of eye and brain. When continued daily, purchasing should be restricted to twenty-five a day: when working for a special object, seventy a day have often been examined, but it is not practicable to do justice to such a number. Very good and very bad animals are soon disposed of; it is the middling and doubtful horses which take up the time: further, it may be accepted as a general rule that the first impressions of a horse are the most correct and lasting. **Restrict purchasing to 25 a day.**

When inspecting a number of horses it is well to mark slightly those that are rejected, so that they may easily be identified, should they be re-submitted. This can be done, without affecting the value of the animal, by cutting a small nick half an inch long in the hair behind the ear. **Mark rejected horses.**

Identification of horses.

On being purchased, horses may be temporarily marked and identified by cutting small consecutive Roman numerals in the hair on the neck under the mane with a pair of scissors. When the description of a horse is recorded for the purpose of identification, only natural marks of a permanent nature should be entered. Saddle and collar galls or harness scars may vary periodically.

Examination on being received into Depôt, and returned if unfit.

On remounts being received into Depôts they should be lunged at once—if fit for it—to try their wind, unless this has been done previously, and they should also be generally re-examined under the direction of the Veterinary Surgeon. Their shoes should be taken off and the feet examined for sandcracks, seedy toes, sunken soles, &c. They should be carefully re-measured and registered, and if, on being re-shod, they are found below the necessary height, or if any unsoundness is detected in eyes, feet, wind or limbs, or if they are found vicious in or out of the stable, they should be returned. On the other hand, if fit, they should be branded on the hoof, in accordance with the Regulations on that subject.

Classification.

Horses in general fall naturally into two great divisions—riding and draught—according to the particular way in which their physical formation and breeding enables them most advantageously to apply their force. A man who has a knowledge and appreciation of horses, can tell to which of these divisions any given animal belongs; but it may be laid down as a general rule that a riding horse should be better bred and should have a more sloping shoulder, a longer forehand, with more flexible and lighter action than a draught horse. Again these two divisions are conveniently subdivided, the first into two, the second into six classes, making altogether eight classes, which would stand as follows:—

1. 1st class riding horses for Officers, Staff-Sergeants, Trumpeters, and the Riding Establishment.
2. 2nd class riding horses for detachments of Horse Artillery and N.-C. Officers of Field Artillery.
3. Horse Artillery lead and centre horses.
4. Horse Artillery wheelers.
5. Light Field Artillery lead and centre horses.
6. Light Field Artillery wheelers.
7. Heavy Field Artillery lead and centre horses.
8. Heavy Field Artillery wheelers.

The difference between 1st and 2nd class riding horses is one merely of breeding, appearance, and degree; the same may be said in comparing classes 3 and 5, and classes 4 and 6 respectively. Heavy lead

and wheel horses (classes 7 and 8) differ from light lead and wheel horses (classes 5 and 6) in having more weight and power. As regards lead and wheel horses whether for Horse or Field Artillery, the low size, thick set horses should be selected for wheelers, those which are higher being told off as centre and lead horses, thus ensuring a regular and upward line of draught. Where practicable the hand horse of a pair should be higher than the near side one.

From the days of Wellington onwards (*vide the Wellington Despatches* 22. 6. 1809, – 27. 6. 1809, – 25. 8. 1809, – 5. 2. 1811, – 10. 2. 1813), there has always been a difficulty in obtaining sufficient riding horses, and when purchasing for the Service, a surplus of officers' and other riding horses may advantageously be taken, for if properly selected, it would be possible to utilise them for draught purposes. Excess of ridinghorses necessary.

Again, if every draught horse which is bought, be powerful enough to be used, when necessary, as a wheeler, the Service would be thoroughly efficient. Excess of wheelers.

Officers in charge of Depôts and Service Batteries must look on young horses when first attached as animals whose constitutions should be studied and nursed. Many of them have been brought up from grass or straw yards where they enjoy air, food, water and exercise at will. To subject them suddenly to confinement on a dry diet, with but spare exercise and limited water, is a change so violent that it is most likely to cause a total derangement of the system: of course the professional aid of the Veterinary Surgeon may be often required, but much may be done by careful, judicious watching, by attention to diet and exercise, and by having the stables thoroughly ventilated. It is not right that a horse should be discarded as a "useless brute" merely because he appears dull and sluggish, whereas he may be only young and green, or sick and feverish. He ought rather to be attended to with greater care, his constitution should be studied and his wants provided for. Young horses to be nursed.

Each animal has a different organization and temperament. The points which indicate health or disease are detailed at p. 127, "Handbook for Field Service," Vol. I. A horse that is a greedy, fast feeder (perhaps jealous of his next door neighbour) may require moving into a detached corner stall. If he still "bolts" his food, increase the chaff given in each feed and damp it all with a little water, the corn will then stick to the chaff, ensuring mastication. Some horses may lose condition from indigestion produced by getting food of the wrong kind, or in undue quantity. A change of situation to a barn or neighbouring loose box or of diet to bran will often restore gloss to the coat, will loosen the hide, and put flesh on the ribs. Then, when the animal is able to take exercise, gradually restore the full diet. Should all changes of air food or alteratives fail, the horse may be found to have worms, the back teeth may be sharp and at fault, and the Veterinary Surgeon's rasp may here be needful. Finally, if the horse is in exercise and supposed to be getting plenty of food and *water*, but still does not recover his condition, and shows no signs of worms, or of sickness, &c., it becomes

a question whether the poor beast really gets his proper and full feed, or whether some illicit use is not made of it. Here the old saying "the eye of the master maketh the horse fat," is most fully applicable, and can alone adjust matters.

It must always be remembered that some horses on undergoing a change of stables, diet, and condition, will recover their tone in a few days or weeks, more especially if the changes can be made gradually; others may remain dull, weak and unnatural for months, though they ultimately become invaluable acquisitions on reaching maturity.

Twice a year, in spring and autumn, when horses are changing their coats, their system is weaker than at other times, a change throughout is going on, and, at these seasons, greater care and attention is necessary in their management, and their work should be lightened.

Plenty of slow exercise at the walk and trot, and an occasional good sweating to get the pores of the skin to act are essential in health, and a good stable manager, who has his horses in good hard going condition will never find his horses fall off on a march, in camp, or on board ship, provided they are cared for, properly "watered" and "fed."

Rock salt in the mangers, or an ounce of common salt given occasionally in the feed checks acidity, assists digestion, and is a harmless natural preventive of much mischief, likely to arise from artificial treatment, confinement, and feeding.

PRÉCIS

AND

TRANSLATIONS.

FRANCE.

I.

SPECTATEUR.

A Review by A. G. of "La Nation Armée," by Baron Colmar Von der Goltz, of the Prussian Staff. Translated into French by Ernest Jarglé, a Professor at St. Cyr.

BY

MAJOR H. H. COSTOBADIE, R.A.

M. Ernest Jarglé has hit upon the bright idea of utilizing his leisure moments and his profound knowledge of German by translating into French Baron Von der Golt's new work. The military world will be grateful to him, for the work shows mature study, and is at once that of a profound thinker and a soldier. It deserves reading with great care, not only by military men but by the world at large. The author himself in his introduction says:—"This book is beyond all things intended to give a clear idea of the nature of war to such whose trade is not war. . . . . . Every sound and vigorous people should know what war means."

Wars, in these latter days, have much changed in character. The Author, a close observer, states, without attempting to explain the fact, that "the days of Cabinet Ministers' wars are over. . . . . The French pretend to this day that they never desired the war of 1870; but when the Empire which declared that war fell, the French people nevertheless determined to continue the struggle at all costs. The man who in July, 1870, loudly uttered the most serious objections to a precipitate declaration of war became himself in September the mainspring and director of the Armies, and the most energetic instigator of a bloody struggle." There can be no doubt that wars now are national wars. This fact cannot be denied, and much may be

learnt from it. Misfortune opens people's eyes; great reverses pull them together, and force them to gain an insight into the causes and consequences of the same. After a great and disastrous war, not only the vanquished, but all others also, seek for knowledge concerning the why and the wherefore of the issue.

A seven consecutive years' war would not now-a-days be the result of a foreign sovereign ironically saying that Cotillon II. or Cotillon III. was the Mistress of the King! Civilized nations will not expose themselves to the dangers of war except for very serious reasons, and nearly all wars become very serious undertakings; hence it is that nations find it necessary to arm themselves *in toto*—in a practical application to themselves of the saying: "*Si vis pacem para bellum*," which saying means, "*if you want peace be ready for war.*"

Nations now-a-days, on the principle that "*God helps those that help themselves*," are not inclined to trust to mercenaries for their protection, and, consequently, arm themselves and stand ready to carry out the noble and immutable law of self-preservation. We may cite as examples, in proof of this assertion:—1. Russia after Jena and Auerstadt. 2. France after Sedan and Metz.

"The age of barbarism is returning!" exclaim the pretended friends of humanity.—"Not at all," triumphantly replies the Baron de Goltz: "This general arming of whole nationalities does not all tend to make them want to destroy each other. Wars will be more bloody but shorter, and the extermination of the vanquished—the struggle to the bitter end—become figures of speech. An enemy is conquered, not by destroying him but by destroying his hopes of victory. . . . . Not only the numbers of the combatants, but all the inventions of science and art are brought to bear in bringing about the desired end in the quickest manner possible, and it is stated that, on the average, battles become less bloody the more perfect destructive engines become." The Author blames, in a manner very much to the point, the subtle theories started by the military schools of the last century. These schools were reputed to be learned. Yet the Author is himself learned—no one can doubt it after reading his work; but he is a scholar, and a sound one. The scholars of the above-mentioned schools were nought but pedants. In speaking of them, the Baron mentions a few anecdotes, not without interest: "Hopfiner," says he, "reports that in 1806 the Prussian troops were encamped alongside great piles of wood—that on the night of the 11th October they were frozen, that on the following day they were without wood to boil their soup—that this wood was not requisitioned until the soldiers had begun on their own responsibility to cut down neighbouring trees. In these same days of distress, corn for the horses was absolutely wanting, although considerable stores of the same were at Jena; but, although the French were close at hand, the Prussian Commanders thought themselves bound to write to Weimar for permission to buy the requisite oats.

"The answer received is not known; but it is known that in the interval the French seized the corn, and that French horses gave a very practical solution to the complicated question. . . . . After

the Battle of Auerstadt, the Prussian troops after being for two days without food arrived famished on the third close to a large village. Prince Auguste, for his dying Grenadiers, requisitioned victuals, as everyone does now-a-days. The peasants made an outcry, and an old Colonel of the Guard was very angry, giving the Prince a severe reprimand, saying that such pillage was not allowed in the Prussian Army, and was contrary to its principles. In 1806, Mapenbach got leave from the Prince of Hohenlohe at Rathenow not to march straight on the Oder, but to make a detour to place a marsh between himself and the enemy. The enemy was not yet near, and the marsh was so dry that it could not have stopped him. The consequence was a defeat at Prenzlaw; but Mapenbach declared that a direct march across the marsh on the enemy's flank would have been monstrous, and such was the spirit of the times that a means of safety was renounced rather than sin against 'recognized rules.' The Baron Von der Goltz justly gives to the French Revolution the honour of having destroyed all the love of minutiæ, all those prejudices, and all the customs of learned pedantry prevalent in the last century.

"A. G. justly asks whether the great lessons taught by the French Revolution have been universally borne in mind, and whether vestiges of learned pedantry and love of minutiæ do not still exist? He thinks that a satisfactory answer cannot be given as long as officers endeavour to lay down immutable regulations for the smallest units—such as companies and squadrons when on the march and in action. Errors must always be made when simple and clear ideas of war are lost sight of, and when an attempt is made to formulate these into propositions requiring proof: to make theorems, in fact, for a subject so practical and real as the art of war. One immediate consequence of the national character of modern wars is conscription. War requires all hands—the young for the first line, the older for the second, and so on. According to the Baron de Goltz, 'man is most apt for military service from 18 to 24 years of age. . . . . In our modern wars it is not necessary for soldiers to have experience. Not so with the Chiefs. For these, war must not be a new thing that surprises and disconcerts them. Experience for these has a real value, and it is only *partially* that the study of military history will supply its place. Again, the fruits of this experience must be gathered by cultivated minds. Let us remember the allegory of the Maréchal de Saxe and his mule.'"

Touching the Officers of the German Army, the Baron's book will teach to many in France, both civil and military, much they will find useful, the more especially to those who think that Officers in Germany all spring from noble or rich families, and who in their own minds attribute to this cause alone German military successes, *et per contra* French reverses. Referring to wealth, the Baron says: "Our Officers, thanks be to Heaven, are mostly penniless."

Referring to their extraction, he says that if German Officers still actually come from the aristocracy of the nation, by this must be understood the aristocracy of well-educated men. Αριστος means the best and not the richest. All the same, it does not either mean that

an officer *should* be poor; on the contrary, in order to preserve in him that juvenile ardour which he requires to the end of his career, it is the duty of the State to ensure for him the means of leading a life *free from cares*—nothing more. The State does not want Officers who can think of nothing else but how to make both ends meet, and who only think of how, free from the burdens of a brilliant misery, they can retire into an unknown corner to live on a moderate pension. Where are such Officers to find that bold and lively impulse so necessary to a Chief in action. Alongside of those who would have all Officers, without exception, belong to the aristocracy or, at all events, to the richest classes are those who—ferocious advocates for others of Spartan simplicity, would have all Officers fare like the soldier. The Baron's ideas are equally removed from both extremes, and he maintains that a great difference should exist between the condition and status of an Officer and that of a soldier.

Regarding discipline, our Author lays down as an axiom that "the worse the discipline of an Army the more despotic is the form it assumes. The word *discipline* is capable of so many interpretations that its meaning seems undefined. It is generally held to mean the keeping up of order, good behaviour, and appearance, the whole to be upheld by strict and severe regulations. To this interpretation the objection exists that severity, good order, appearance, and behaviour are not equally developed at one and the same time. No armies have ever existed better disciplined than those of the Germans during the late campaigns, and yet these were governed by the kindest of regulations, by laws kinder than any that ever governed any large army in the field. *Per contra,* we find in ancient and modern history that Draconian justice and want of discipline went hand in hand. It is none the less true that a sufficiently severe law is necessary to give a tone of immutable necessity to all essential regulations: for instance, disobedience of orders should be promptly and sufficiently punished on all occasions. This strict observance of law is the true basis of discipline. By carefully studying it we shall find that great and small in an army must equally obey. Hence it is," adds de Goltz, "that the principle in the German Army of making the Officer begin like a simple soldier is an excellent one."

The Author devotes a long chapter to the requisite qualifications of a General. For these, in his estimation, "character" ranks first and "will" second. But, he adds, well-tempered characters show themselves generally in times of peace in a way that is not favourable to promotion. Without the French Revolution Buonaparte and Carnot would probably have ended their days as Colonels. Frederick the Great, had he not been born on the steps to a throne, would probably have been pensioned as a Lieutenant. To the above two great desiderata in a General, the Baron adds ambition, love of glory, and greatness of mind. Further, a general must have a great knowledge of human nature and an immense power of discernment. The last quality Napoleon, according to Jomini, possessed in a supreme degree. Good health and courage must be possessed as a matter of course; but

by courage in a General the Baron means a supreme contempt of death, a courage that is in no way artificial, and which danger only sharpens to sharpen with it all the good qualities of the man. The Baron holds that many of these qualities requisite in a General can scarce exist without a certain amount of selfishness and want of feeling. A. G. does not agree with the Baron on this point, and asserts that most great leaders have won the affection of their soldiers. In support of his assertion he cites Turenne, Catinal, Frederick the Great, the Archduke Charles, and Bugeand, who all earned from their men the sobriquet of "Father;" and as to selfishness, he declares such to be the death of all patriotic feelings—essential attributes of a man of war. Finally, the Baron, without actually saying that a General must be of noble birth, seems to hint that such is very requisite to him, and almost a necessity. Gustavus Adolphus, Bernard de Saxe-Weimar, Frederic William, Condé, Turenne, Eugène, Charles XII., Frederick, either wore crowns or were precious near to one. He forgets, however, to mention that Fabert, Catinal, and others were not noble, and that although Napoleon sprung from a patrician family in Corsica, the circumstances of his earlier days and early manhood were not in the least calculated to help him on in his career.

The Baron lays great stress upon the faculty of being able to give orders in a clear, cool, and concise manner, no matter what the confusion around may be. He who gives confused orders may be brave, but is unfit to command.

The Author, diving slightly into the future, makes a few remarks on the sure accession of power to Infantry fire by the adoption of repeating rifles; and as regards powder, he says that, with the present incessant strides of science and manufactures, powder is doomed, that it is still used because a proper substitute has not yet been found; but that finding one is only a matter of time. Should a powder be discovered making no noise and no smoke, then indeed will there be a revolution in tactics.

The Baron would encourage Officers to have no fear of acting on their own responsibility whenever such would appear necessary to common sense. "Whenever subalterns show no power of taking the initiative, the fault lies with their superiors."

GERMANY.

I.

"ORGAN DER MILITÄR-WISSENTSCHAFTLICHEN VEREINE," 1883,
PARTS 2 AND 3, VOL. XXVII.

BY

LIEUT. J. M. GRIERSON, R.A.

THIS double number opens with a detailed account of the Russian Manœuvres at Warsaw in 1882, which, from all accounts, were not of the most instructive character. The troops engaged were, for the Northern Corps, 28 Battalions, 24 Squadrons, 46 Guns, and 8 Engineer Companies; for the Southern Corps, 38 Battalions, 29 Squadrons, 66 Guns, and 4 Engineer Companies. It may be noted, also, that 2 Heliograph Detachments were attached to the Northern Corps, but these, on account of the bad weather, had no opportunity of displaying their skill. The paper gives an account only of the two final days of the manœuvres, in which the Northern Corps was thrown successively out of two fortified positions, by its left flank (the right was pivoted on Warsaw) being turned. As in the German manœuvres, the Cavalry of both Corps was massed on the outer flank, but, unlike them, we read of no attacks "*à l'arme blanche*" (except in one isolated case, where some Dragoons debouched from a wood and attacked an Infantry battalion on the march); on the contrary, the Russian dragoon seems during these manœuvres to have (as his training inculcates) considered his horse as a means of locomotion, much as a bicycle might be looked upon, but as a bicycle with those unfortunate appendages—a stomach requiring to be fed and a coat requiring to be groomed. The Cavalry appears also to have been badly handled on the Northern side, for the Guard Brigade sent out to scout to the right front, on being driven in, retired away from its Infantry support, the latter, therefore, being considerably cut up, and the Division on the left succeeded in so manœuvring as to be forced to retire along a long causeway with swamps on both sides, parallel to the enemy's front, and under his fire. The Artillery seems to have played a minor part, as it is hardly mentioned. The degree of instruction and appearance of the Infantry apparently left little to be desired, and it again gave proof of wonderful marching power. The 2nd Rifle Brigade is stated to have done more than half of a twelve-mile march at the double! As regards

staff arrangements, the orders for the march of the Southern Corps are sharply criticised, as the composition of the columns laid down in the order of march necessitated several brigades crossing one another's line of march. In the defensive position taken up by the Northern Corps, 10 battalions (5000 men) occupied a line $2\frac{3}{4}$ miles long, as general reserve for which were detailed 3 Companies of Engineers! In the defence of the position, several local counter-attacks were made, but in most cases these were made too early and pushed too far. Between the two days' manœuvres, both Corps bivouacked as on service, with outposts, &c., and the account of the disposition of the Southern Corps, as sent in by the Cavalry of the Northern Corps to their headquarters reads amusingly when compared with the actual state of affairs.

The second paper is a study on the conditions which a repeating rifle has to fulfil, which is full of technical interest as a question of small arms. It is followed by a biography of the late Lieut.-Field-Marshal Gallina, the author of the well known standard work, "*Die Armee in der Bewegung*," and who had performed most excellent service as a Staff Officer in the two model campaigns of the Austrian Army of late years, 1849 and 1866, in Italy.

A paper on the Tirol Landsturm is of more local interest, and an attempt at a species of organization[1] is sketched out, in which some valuable hints for the formation of a *levée en masse* are contained.

The next paper is an account of an experiment in the utilization of the electric light for searching a battle-field at night for wounded men, made at Vienna on the 22nd of October, 1883. The apparatus for lighting the field was carried on a wagon drawn by four horses, costing 25,000 francs, and throwing a light equal to that of 12,000 candles to a distance of 3000 mètres. Twelve such wagons have been ordered for the French Army, and though this trial was in some respects a failure, still such a method would undoubtedly render great services on one of the large modern battle-fields. In 1870, for instance, the battle-field of Gravelotte was not cleared till four, and that of Sedan till six days after the action, and it cannot be doubted that if those fields could have been lighted up by night, the time would have been much shortened and many valuable lives saved.

The most interesting paper of the number is, perhaps, the last, that by Archduke John, on "Drill or Military Education" (*Drill oder Erziehung*), in which he declares himself for the education of the *morale* of the soldier rather than his being drilled into a machine. He says that drill has come to be looked upon as a talisman, as the sole cause of success in warfare, and that the theory that the German successes in 1870 were entirely due to their splendid drill and discipline has been commonly adopted and slavishly followed. This theory he combats, saying that the German successes were due to the high feeling of duty, the strength of will, and the staying power (*Ausdauer*), shown by all

---

[1] It has none at present, but includes all males between 18 and 45 years of age. It is entirely distinct from the "Tiroler Landes-Schützen," or organized Landwehr.—*J.M.G.*

ranks rather than to mere drill. In his own words:—"In Prussia, parade drill is a luxury which the Prussians can allow themselves, although they do not go altogether unpunished for it,[1] while with us it is a sin." And he justifies his words by saying that the Prussian recruit, being a much better educated man than the Austrian, can afford to dispense with a good deal of the moral education which is absolutely required by the latter. Modern rifle fire exercises such a powerful effect on the nervous system of men that some means must be sought to counterbalance it, and this means he would find in raising among the men the feeling of love and respect for their officers, of devotion to their country, and of loyalty to their sovereign. The men should be praised where possible, and never blamed without their mistakes being explained to them. Men *will* be human, and under a heavy fire will with difficulty understand such appeals as Frederick II. made to his retreating Grenadiers at Kolin: *"Rackers! wollt ihr denn ewig leben?"* (Scoundrels! do you wish to live for ever?) No, says the Archduke, education must take precedence of drill, and as the time allowed is but short, parade drill must give way to education of the *morale*. The paper is exceedingly interesting and written in a lively and pleasant style, though probably everyone will not agree with its conclusions.

No. 4.

The three papers in this number are:—"The System of Groups from the points of view of Tactics, Strategy, and Fortification;" "First Help for the Wounded;" and "Food, with Special Reference to that of the Soldier;" none of which offer any points of special interest.

In a translation from the *"Avenir Militaire"* on the French Manœuvres of 1883, we find the following remarks on the Artillery:—"Nothing but praise for the Artillery is heard. On seeing the heavy machines taken over ditches and up and down hills, it appears as if officers, men, horses, and even the carriages were animated by the same spirit. Batteries were seen taking up position in very broken ground and coming at once into action, and the positions were always well chosen. Peace manœuvres do not permit an opinion to be formed on the skill of the Nos. 1 nor the effect of the fire; but judging from the results of the practice on the ranges we may conclude that an Arm which shows such precision and quickness, combined with steadiness on the manœuvre-ground, will be equally well trained in its other duties. One feels instinctively that with the Artillery Regiments the manœuvres are not mere parade, but sober earnest. The Artillery inspires every confidence."

[1] St. Privat.—*J.M.G.*

THE EGYPTIAN CAMPAIGN OF 1801.

BY

MAJOR S. C. PRATT, R.A.

The influence of France on the continent at the commencement of the century was notably great; the strength of Austria had been entirely broken by the Marengo campaign, Italy and Switzerland were submissive to the Republic, Holland was in its power, and Spain had openly thrown in her lot with the Buonapartes. England, on the other hand, had been almost uniformly successful in her naval operations, had acquired an Indian empire and vast colonial possessions, and had just crushed the great Northern Confederation in their attempt to ruin British trade. The maritime superiority of the Briton was as unquestioned as the military success of the Generals of the Revolution. After ten years of costly and burdensome warfare, the two great rivals stood alone unconquered; and, weary of strife, sought to arrive at a mutual understanding. France had depleted her population, and England exhausted her treasury, and it seemed advisable to come to some arrangement as to the division of the spoils. While negotiations were proceeding, it was to the interest of each nation to strengthen to the utmost their political position in order to gain the most advantageous terms. Buonaparte took vigorous measures to push forward the war in Portugal, and ostentatiously assembled the troops of an invading force on the coasts of the Channel. England collected a large fleet and army, with the intent of striking the French interests in Spain and the Mediterranean. The military force of England had hitherto been either inactive or misdirected, and to bring on a contest on fairly even terms was a matter of some difficulty. The credit of planning the invasion of Egypt appears mainly due to Mr. Dundas, the War Minister, who had some difficulty in persuading the King and the Cabinet of the feasibility of his project.[1]

Judged as a measure of policy, an attack on Egypt was, without doubt, sound. The negotiations between the contracting Powers were being framed on two hypotheses; one in which France retained Egypt as a set off to our Indian possessions, the other, in which she gave it up, receiving other compensation. The expulsion of the Republican army from the country in dispute, would materially strengthen the hands of the English diplomatists.

The time chosen for the offensive movement was, moreover,

---

[1] Memoir of Sir R. Abercromby.

peculiarly suitable. The victory of the Nile had virtually cut off the intercourse between Egypt and France; the army of Italy, deserted by its chief, was suffering in *morale;* money, ammunition, and supplies were failing; and the desire of the French troops to abandon an uncongenial task and unhealthy soil, was tolerably clearly indicated by the alacrity with which the convention of El Arish had been signed. The failure of Sir Sydney Smith to ratify the terms of peace led to their temporary rejection, and to the decisive overthrow of the Turks at the battle of Heliopolis. The levies of the Vizier were completely disheartened, but it was manifest that the successful entry of a European Power on the theatre of war would revive the position of affairs that existed prior to Klebers death, and probably lead to the acceptance of favourable terms of capitulation.

A powerful English force, eager to atone for the failures of Ferrol and Cadiz, lay in hurtful inactivity at Minorca and Gibraltar. The means were at hand, the political and general situation was favourable, the proper season for military operations had arrived, and a leader, skilled in war and possessing the confidence of the Ministry, was available to carry out their plans.

Lord Elgin, the British Ambassador, was instructed to induce the Porte to make a final effort, in conjunction with the British Army, to expel the French from the delta of the Nile. A joint English and Turkish force, under Sir Ralph Abercromby, was to endeavour to effect a landing on the Mediterranean coast; the army of the Vizier, starting from Syria, was to co-operate by marching through the desert direct on Cairo, while an expedition from India and the Cape was to assemble on the Red Sea coast, and create an effective diversion in Upper Egypt. "So great and extensive a project had never been formed by any nation, ancient or modern; and it was not the least marvellous circumstance of this eventful period, that a remote province of the Roman Empire should have assembled at the foot of the Pyramids, the forces of Europe, Asia and Africa, in one combined enterprise, and brought to the shores of the Nile tribes unknown to the armies of Cæsar and Alexander."[1]

Early in November, 1800, the fleet conveying the army of invasion, started from Gibraltar, and, after a boisterous passage, reached Malta, where the troops were disembarked, the ships cleansed, and provisions laid in. It was the desire of the Government that the expedition should sail direct from Malta to Egypt. A second rendezvous was, however, found necessary, in order to ship the horses and supplies promised by the Porte, to arrange for the collection of small vessels for landing purposes, and, above all, to find to what extent the co-operation of the Turkish forces might be looked for. The information possessed about Egypt was most meagre; there were no reliable maps, and the accounts of the strength and condition of the French forces, and the measures they had taken for the defence of the country, were most contradictory. The impression left upon Sir Ralph's mind as to

[1] "History of Europe."—*Alison.*

the difficulty of the task he had undertaken is clearly indicated in his correspondence with the War Minister.[1]

On the 1st January, 1801, the vessels of the fleet were assembled in Marmorice Bay on the south coast of Anatolia. A long delay here took place owing to the obstructive policy of the Turkish Government. Major-General Moore (afterwards Sir John Moore) was sent to Jaffa, and reported that it was in vain to expect any co-operation from the army of the Vizier.[2] The promised Turkish gun-boats did not arrive, and necessitated delay till flat-bottomed boats and small vessels could be collected from Rhodes and Smyrna. The time, however, was not entirely wasted. The experience of the attempted landing at Cadiz had shown that the arrangements of the fleet, for transferring troops to land, were very defective. The expeditionary force was accordingly daily practised in embarking and disembarking with rapidity, and the carefully detailed instructions then issued have been subsequently taken as a model for similar operations.[3]

It was soon apparent that the Porte was somewhat suspicious of the motives influencing the English Government, and that little assistance could be hoped for until such a footing was obtained in Egypt as would justify a reasonable hope of ultimate success. Nothing was known as to the progress made by the Indian contingent, but it was evident that the element of weather alone would make its certain co-operation at any fixed date an impossibility. It became necessary to trust to the English army alone, and to decide on a plan of operations commensurate to its strength and ability. The fighting value of the expeditionary force was greatly enhanced by the presence of a powerful fleet, and the capture of the only good harbour on the Egyptian coast became a matter of primary importance. A plan of landing at Damietta, and marching direct on Cairo, was discussed, but abandoned as impracticable.[4] The best point for disembarkation was, without doubt, Aboukir Bay, as the anchorage was sheltered, and, if the landing was once effected, the inland Lake of Aboukir could be utilized for the purposes, both of defence and supply, by the smaller vessels of the fleet. A direct advance, with both flanks protected, could then be made on Alexandria, and the city be captured by a combined sea and land attack. With the sole useful sea-port in British hands, with a fleet cutting off all succour from France, the isolated position of the temporary possessors of Cairo, amidst an unfriendly population would probably lead to their capitulation.

---

[1] "I think it necessary to apprise you that the service on which we are going will not probably be so soon performed as you may expect."—*Letter to Mr. Dundas.*

[2] "A wild ungovernable mob, incapable of being directed to any useful purpose . . . . . destitute of everything that is required in an army, and their Chief, a weak-minded man, without talent or military knowledge."—*Life of Sir J. Moore.*

[3] "The plan of the English disembarkation was imitated from the one adopted by Sir Ralph Abercromby, when he made his famous descent upon the coast of Egypt."—*The Invasion of the Crimea: Kinglake.*

[4] The difficulties of crossing the bars at the mouth of the Nile in rough weather are great. The forwarding Artillery and supplies over the Rosetta bar, during the advance on Cairo, caused more loss of life than the Republican bullets.

The plan of effecting a landing in Aboukir Bay was explained to the General Officers of the Army. The sick and unfit for service were sent into a hospital at Rhodes; and the signal for the whole fleet to sail was made at 7 a.m. on the 22nd of February, 1801. By 5 p.m. all the vessels had cleared out of the Bay, and the formidable fleet of 200 vessels crowded sail, running before a fresh northerly breeze. The honour of England was now definitely pledged to a most hazardous enterprise, and one, the difficulties of which seemed almost insuperable.[1] "Never was the honour of the British army more at stake, or its animated exertions more required; and never was the interest of the country more deeply involved than in its ultimate success."[2] After a somewhat stormy passage the greater part of the fleet anchored in Aboukir Bay on the 2nd March; but landing was impossible owing to the roughness of the sea and the violence of the surf. The shore was reconnoitred and a place of landing fixed on not far from the Castle of Aboukir. The enemy had evidently guns in position on the sand-hills overlooking the beach; and from information given by a prisoner, it was known that any attempt to disembark would be directly disputed by a force of some 2000 men with 15 guns (exclusive of the heavy guns in Fort Aboukir.)

The weather did not moderate for some days, and ample time was given to the French troops to strengthen their defences. The invading army was composed as follows:—

Troops (including sick) on board ship in Aboukir Bay, 7th March, 1801.[3]

Infantry Brigades.

Major-General Ludlow (Guards Brigade)	Coldstream Guards ...	944
	3rd Regiment	981
Major-General Coote (First Brigade)	The Royal Regiment ...	741
	54th (2 Battalions) ...	1162
	92nd Regiment	766
Major-General Craddock (Second Brigade)	90th Regiment	851
	8th "	538
	13th "	760
	18th "	523
Major-General Lord Cavan (Third Brigade)	50th Regiment	574
	79th "	711
Brigadier-General Doyle (Fourth Brigade)	The Queen's Regiment ...	656
	30th Regiment	513
	44th "	361
	89th "	472
Brigadier-General Stuart (Fifth Brigade)	Stuart's Regiment	1058
	De Rolle's "	635
	Dillon's "	647

[1] "I never went on any service entertaining greater doubts of success."—*Letter of Sir R. Abercromby to Colonel Brownrigg.*

[2] Journal of Sir R. Abercromby.

[3] The Parade State is given in Walsh's "Campaign in Egypt."

Major-General Moore (Reserve Brigade)	23rd Regiment	563	
	28th "	693	
	42nd "	869	
	58th "	563	
	Corsican Rangers	240	
	46th Regiment (2 Compies)	289	
	Staff Corps	89	
	Total Infantry ...	16,199	16,199

Cavalry Brigade.

Brigadier-General Finch	11th Light Dragoons ...	62	
	12th " " ...	543	
	26th " " ...	447	
	Hompesch's " ...	161	
	Total Cavalry	1213	1213
Brigadier-General Lawson	Artillery	719	719
	Grand Total		18,131

The great bulk of the force were long-service men who had been enlisted for life. The Infantry were well drilled and in good condition, but the Cavalry and Artillery were very weak. The Cavalry started without horses, and only obtained them by degrees. Of 700 bought at Constantinople a large proportion had to be shot as absolutely valueless. A few troopers of a better type were purchased while the fleet lay in Marmorice Bay, and others were subsequently procured after the landing in Egypt had been made. The effective force of the Cavalry may be put down as about 500 sabres.

The artillery with the troops comprised some light field ordnance which had been landed at Ferrol, and re-embarked in so disorderly a manner that not one piece was found fit for immediate service.[1] The long delay that took place at Marmorice was utilized in arranging a mounted equipment for 3-prs., 6-prs., and royal howitzers; the horses purchased for the mounted corps were of a wretched description, and of these the troopers rejected by the Cavalry were thought good enough for the guns. It was found quite impossible to use the ordinary service equipment; the harness had to be taken to pieces and the collars replaced by an extemporised breast attachment; pole draught, as soon as practicable, was, in all cases, substituted for the shafts, and arrangements were made for replacing the ammunition wagons by light carts. Sixteen light field pieces were first landed, but subsequently some 12-prs. accompanied the force in its advance on Cairo, drawn by a mixed horse and oxen draught; the heavier guns, 24-prs., mortars and carronades, when used on shore, were almost wholly conveyed by water, except for very short distances. If from the total field force is

[1] Memorandum by Brigadier-General Lawson.—*R. A. Institution Papers, Vol. XII., p. 216.*

deducted some 800 sick, and the whole of the non-combatant services, it leaves an effective fighting force of about 14,000 men, including 500 sabres and 16 field guns.

The actual French force in Egypt at the time of landing is difficult to correctly estimate. A careful comparison of the disembarkation returns[1] with the parade states given by Reynier and Jomini,[2] shows that the numbers of the army (exclusive of foreign auxiliaries) was about 27,000 men. Of these, according to Jomini, 15,000 were an effective field force, while 7000 were capable of only garrison work. The remainder were sick and non-combatants.[3] The accuracy of the French historians of the Revolutionary wars is often questioned, but in this campaign there are several effective means of checking their statements. Making a fair allowance for non-combatants, it appears that at the date of landing the number of the effective French field force was slightly in excess of that of the English, but that they were better provided with Cavalry and Artillery. As the campaign progressed, the English received reinforcements amounting to nearly 5,000 men, and obtained a numerical superiority. Some 7,000 French garrison troops were available for the defence of Cairo and Alexandria, and the forts on the sea coast; but, on the other hand, the valuable assistance to the Allies of the Fleet with its numerous gun-boats must be estimated at a high figure. The difference between the numbers of the contending armies was not such as to justify, from that cause alone, a hope of success; and it may be fairly agreed that their fighting value was about equal. The assistance of the Turkish armies, the defection of the Mamalukes from the French cause, and the diversion created by the Indian contingent, weighed naturally in the English favour.

In the beginning of March the general situation of the French combatant army was as follows:[4]—

At Cairo	11000
At Alexandria, Rosetta, Rahmaniyeh, and Coast Forts	6000
At Damietta, Mansurah, and Coast Forts	1800
Salahieh, Belbeis, and Suez	1000
Upper Egypt	1700
Total	21500 men;

(including about 1800 Cavalry, and 60 field guns.)

The Infantry were good troops and well equipped, and contained in their demi-brigades many of the veterans of the army of Italy. The "Cavalry was superb, equalling the Mamalukes in bravery, and far

[1] Wilson's "Expedition to Egypt."

[2] "De l'Egypte."—*Reynier*. "Guerres de la Revolution."—*Jomini*.

[3] In the recently issued Report on Egypt (Intelligence Department) the field force is put down at 18,000 men.

[4] "De l'Egypte."—*Reynier*.

surpassing them in discipline,"[1] The mounted Artillery was in a high state of efficiency, and the Dromedary Corps had proved its exceptional utility.

The *morale* of the army was not, however, good. Even while Buonaparte was with it, there were signs of insubordination, due mainly to a disappointment that their exaggerated ideas of the glories of the East were not realized, and also to a longing to return to their mother country. After the death of Kleber, Menou became General-in-Chief by the right of seniority, and worked laboriously for the organization and permanent occupation of the colony; a policy, naturally unpopular to those whose vision was always directed towards France. Constant disputes arose between him and his Generals of Divisions, and doubts were openly expressed as to his military capacity. The intemperate opposition of Reynier, Friant, Lanusse, and other Generals, to the administrative measures of the Commander-in-Chief, led subsequently to that want of accord in the military operations which experience has always proved to lead to disaster.

The doubts that may have existed as to the ultimate destination of the English Fleet were removed in January by information received from spies; the place of landing was also well known. It was barely possible that a disembarkation should take place anywhere else but in Aboukir Bay, and this opinion was confirmed by the capture of British Officers reconnoitring near Aboukir Castle on the 28th of February. Menou, however, had still his attention fixed on the army of Syria, and made no sign of movement till the news of the English Fleet being in sight of Alexandria reached Cairo on the 4th of March.

The strategical situation was now perfectly clear. The two dangers that menaced Egypt were a landing of the English near Aboukir, and an advance of the army of the Vizier from Syria by way of El Arish. It was well known that the Turkish Commander was not in a position to advance at once, and that even if he were, it was extremely improbable that he would make the attempt until he learnt of the success of the English. It was quite sufficient to leave a small mobile corps at Cairo, hold the entrenchments at Salahieh and Belbeis, and throw the whole weight of the army on the English. Even if it were too late to oppose the landing, the invaders could be attacked in force in an unfavorable position. The ultimate design of the English would undoubtedly be to capture Alexandria, but, at the same time, an advance on Cairo had to be guarded against. Every consideration pointed to the advisability of an initial concentration at Rahmaniyeh of the whole available field force.

Menou appeared quite unsettled as to how he should act, and, in spite of the remonstrances of Reynier,[2] forwarded two demi-brigades to Belbeis, three to Rahmaniyeh, and about 500 men to Damietta. When every moment was of value, the Commander-in-Chief remained at Cairo to await further intelligence of the English movements; while the

---

[1] "Consulat et l'Empire."—*Thiers.*

[2] *Vide* the interesting letter of remonstrance sent on 4th March. "De l'Egypte."—*Reynier.*

General at Alexandria was left to take the defensive measures he thought necessary.

The weather having somewhat moderated, a reconnaissance of the shore was made on the 7th of March, and the point for disembarkation definitely fixed on.

The Naval and Military Officers in command had had some six weeks to study the detailed instructions for landing; and the delay in Marmorice Bay had given them some practical experience. The general plan for disembarkation was as follows[1] :—

The boats were to form up at a rendezvous opposite the shore in three lines. In first line were large flat-bottomed boats capable of holding 50 soldiers, and the launches carrying the field guns. A distance of 50 feet between the boats was to be kept, and warning given that the line must not be broken by boats forging ahead or dropping astern. The second line was composed of the ships' cutters, with the duty of attending on the flat boats, and affording them assistance if necessary. The third line was cutters towing launches filled with men of the same regiment as those directly in front of them. The second and third line were to land in the 50-foot intervals when the shore was reached by the first line. The boats of the first line on nearing the shore were to drop grapnels from their stern, and haul off as soon as the troops were landed. The whole of the boats were, for purposes of command, collected in divisions, each under a Naval Captain, who followed the signalled directions of the Officer superintending the disembarkation.

The Brigade of Guards, the Reserve Brigade, and a portion of the First Brigade, with 16 guns, were to be first landed. The men were ordered to sit down in the boats, preserve the strictest silence, and on no account load till formed up in line on the beach. 60 rounds of ammunition and three days' provisions were carried by each man, and three more days' supplies packed in the boats. The signal for disembarkation was given early on the morning of the 8th March, and at 3.30 a.m. the first Division, 5500 strong, started from the transports for the rendezvous near the shore. The place of assembly was marked by three armed vessels anchored out of gun-shot from the beach. A few gun-boats and armed cutters were ordered to cover the landing with their fire. Owing to the distance at which the larger transports had to lie off the land (some 9 or 10 miles), it was not till 9 a.m. that the lines of boats were formed up. The signal for advance was given by Captain Cochrane.

The Bay became a scene of intense animation; one hundred and fifty boats moved forward in silence with intense rapidity. Not a gun or Frenchman was to be seen on the beach or sand-hills. For two hours, however, the enemy had been quietly waiting. General Friant had placed his force of 2000 men in a concave semi-circle on the sand-hills, with his left resting on Aboukir Castle, and his guns in action on a lofty bluff that commanded the whole shore. As the boats came

---

[1] The orders in detail are given in "Wilson's Expedition to Egypt."

within range a heavy fire was opened, and the surface of the water seemed so ploughed up with shot and shell, grape and musketry, that it seemed impossible that anything on it could live. Several boats were sunk, and the loss among the crowded crews of the rest was very severe. As soon as the front line of boats touched the sand the men jumped out and formed on the beach with great celerity. The 23rd and 40th Regiments, followed by the 42nd, charged up the sand-hills without firing a shot, and carried all before them. The sailors dragged up some field pieces, and secured the position. A detachment of the Guards and Royals were meanwhile momentarily put in disorder by a charge of French Cavalry, but reinforcements, continually landing, put an end to all resistance. General Friant retired with a loss of 300 men and 8 guns[1], and took up a strong position across the sandy isthmus which led to Alexandria. The British loss was 652 men, exclusive of the seamen in the boats. The remainder of the troops were landed in two more trips, and the whole force advanced some three miles along the isthmus, and bivouacked in four lines. Armed launches and boats were pushed into Lake Aboukir, and depôts of supplies and provisions were formed on its banks. Aboukir Castle being still in the enemy's hands, the Queen's Regiment, and some dismounted Dragoons were left to invest it till heavy guns could be landed. The landing of horses, forage and supplies took some time, and it was not till the 12th of the month that an advance of some four miles towards Alexandria was made. The delay was unfortunate but not difficult to account for. The English Cavalry was too weak to effectively reconnoitre, the strength of the enemy was not known, and there was a natural tendency to caution in the closing of untried troops with the far-famed veterans of France. If a little more enterprise had been shown, the army might have advanced without resistance as far as the sweet water canal, and have secured at once the position which a few days later cost many valuable lives to take.

The news of the landing reached Menou on the afternoon of the 11th of March. Under precisely similar circumstances, Buonaparte, in July, 1799, when the Turkish army landed at Aboukir, ordered a concentration at Rahmaniyeh, and with his head-quarters reached that place in four days.

By calling in the outlying garrisons the whole field army might assemble at Alexandria in a few days. Menou, however, thought it undesirable to materially alter existing arrangements; and, after leaving strong detachments in upper Egypt, Cairo, Belbeis, Salahieh and Damietta, marched the remainder, about 7000 men, towards Alexandria. A practicable route across Lake Mareotis was discovered (the direct route along the sweet water canal being at the time in the hands of the English), and the whole force was united under the walls of the city on the 19th of March. While this movement was progressing an important action took place near Alexandria. General Friant had been reinforced by troops from Rahmaniyeh, and with a field force of about 5000 men and 21 guns, resolved to defend the heights near the old

---

[1] "Memorial de St. Helène."—*Las Cases.*

Roman camp, and endeavour to keep open the main route to Alexandria till after Menou had arrived.

The march of the English on the 12th of March was retarded by the French Cavalry; and, after advancing some four miles, it was evident that the enemy had made a stand. As the day was far advanced, the troops were directed to bivouac, and orders given for attacking the position the next morning. A range of sandy-hills stretches across the narrow isthmus, barring the roads to Alexandria, and on it were placed the French troops, with their Batteries well to the front. The Division of General Lanusse occupied the elevated land near the sea; that of General Friant the heights in the centre, and the ground on the south as far as the canal. The Cavalry was posted between the two Divisions.

General Abercromby determined to assault the position in front, and turn the enemy's right flank.

The army advanced from its bivouac in three columns, the centre and left columns each consisted of three brigades, formed one behind another, in column of companies. The 90th and 92nd Regiments formed the advanced guards. The third column in similar formation, but somewhat behind the others, kept on the right along the sea coast, and formed the reserve. As the centre and left columns came under artillery fire, they deployed, forming two lines, with the rear brigades in support. The reserve still retained its column formation. The march of the English army was somewhat concealed by the undulations of the ground, and the French General saw the reserve and left columns sometime before the presence of the central one became visible. Believing these two columns to be beyond the reach of mutual support, an attack was at once ordered, but while in process of execution, the deployed lines of the central column made their appearance. The effect of the miscalculation was at once apparent. The French had descended from their strong position and were attacking a force, well in hand, of about three times their strength; a brilliant Cavalry charge was made against the centre of the English line, but was repulsed by the 90th Regiment in line.[1] The odds were too unequal, and the French force retired in good order to the heights of Nicopolis just outside Alexandria. The advance of the English was slow, owing to their having to drag their artillery by hand through the heavy sands, and, as they neared the new French position, they were checked by artillery fire. A long delay now took place while the position of the enemy was being reconnoitred, and, after a half-hearted attempt to assault his right flank the army retired to the heights which the French occupied in the morning. The killed and wounded amounted to 550 French and 1284 English. The slowness of movement of the English army, and the excessive caution showed by its Commander are vividly apparent in this engagement. That the French in their rash attack, and subsequent long retreat over open ground, should have suffered so little loss, evinces no little tactical ability on their part. On the other hand,

[1] "The French claim to have ridden down two Battalions in this charge,"—*vide Reynier and Jomini.*

while every credit must be given to the exertions and gallantry of the English army, it is evident that a grave mistake was made in halting the troops under the fire of the guns of the second French position. Either the pursuit should have been rigorously followed up, and the heights of Nicopolis at once assaulted and turned,[1] or the army should have checked its advance until a decision as to the best course to pursue had been formed. The course adopted of leaving troops to remain under fire awaiting orders while a reconnaissance was taking place, was contrary to ordinary tactical rules.

The expedition, hitherto, had been fairly successful, and the greatest of the anticipated obstacles overcome. A landing had been effected, abundant water was found, supplies were disembarked with ease, and the French were driven into Alexandria, and their main line of communication with the interior cut off. It was evident, however, that an action of a decisive nature must take place before Alexandria, as the mere occupation of the barren Isthmus of Aboukir was of no service to the English Ministry. The French had to be driven out of Egypt, or the expedition would be a failure. So fully was this realized by General Abercromby, that he commenced making arrangements for pushing forward his artillery at night, and assaulting the French lines in the dawn of a succeeding day.

Working parties were meanwhile strengthening the position of the army by throwing up batteries, in which 36 field-pieces were posted. Ammunition, tents and stores were landed at the head of Lake Aboukir, and markets established to encourage the peasantry to bring in food.

The position itself extended from the head of Lake Aboukir to the sea—about a mile—and was, by nature, strong. On an eminence on the extreme right were the ruins of an old Roman palace, which afforded good cover. In front of the centre the ground was quite open, and sloped down to a sandy plain. On the left was an open marsh, swept by the artillery on the hills, and in rear of the flank was Lake Aboukir, and some of the armed launches of the fleet.

The army was encamped in two lines. In front line were four Brigades bivouacked close to the actual line of defence, the Guards being in the centre, and the ruins on the right being held by the Reserve. In second line, behind the hills of the position, were three Brigades with the Cavalry in front of them.

While the army was thus resting, intelligence arrived of the surrender of Aboukir Castle on the 17th of March. On the 18th, a Cavalry skirmish took place in front of the left flank, in which the English showed more gallantry than discrimination, and suffered severely. On the 20th, a body of troops was seen in the distance crossing the bed of Lake Mareotis, which proved to be the reinforcements[2] from Cairo, with General Menou in command.

The total French field force under the walls of Alexandria was now

---

[1] "Un général vigoureux . . . . . aurait de suite attaqué la position sous Alexandrie."—*Jomini.*

[2] A warning was sent by an Arab Chief to the effect that Menou was going to Alexandria, and would endeavour to surprise the British Camp.

about 10,000 men, and it was decided to attack the English lines without delay at day-break the next morning.[1]

The plan of operations was as follows :—The troops were to fall in without noise at 3 a.m., and march in silence towards the enemy's position, so as to effect a surprise in the early dawn. A false attack was to be made on the canal, towards the English left, by the Dromedary Corps. The left wing, under General Lanusse, was to make the main attack on the English right, and be supported by the troops of General Rampon, who was to occupy the attention of the centre. The right wing, under General Reynier, was to keep somewhat back until the British flank was turned, when a general advance was to be made, with the object of throwing the English army back in confusion on Lake Aboukir. The Cavalry and Reserve Artillery were posted in rear of the centre to await the course of events.

The English army was as usual under arms an hour before dawn. A smart fire of musketry was heard on the extreme left, but it was soon evident that the firing was too feeble to denote a serious engagement. The attack of the Dromedary Corps had been partially successful, a *flèche* on the canal was temporarily captured, and a few prisoners made.

Elsewhere along the line there was a few minutes of anxious suspense, as nothing could be seen in the grey morning mist. Loud shouts were suddenly heard on the extreme right, succeeded by a roar of musketry, and the action became general. The Division of Lanusse, favoured by darkness and the undulating ground had advanced unperceived to the outpost line, and driven in the picquets with great rapidity. The two demi-brigades pressed forward against the lunette in front of the ruins (held by the 28th Regiment), and endeavoured to pass it on both sides. The troops that penetrated thus far into the position came under the fire of the 58th and 23rd Regiments posted in the ruins, as well as that of the rear ranks of the 28th, who faced about. The confusion thus caused was increased by the intermingling of troops from General Rampon's Division, and the steady fire of the 42nd, who had advanced on the left of the redoubt. The attack on the Reserve Brigade was completely checked, and the French retired, leaving about a Battalion prisoners. The columns of the French centre, meanwhile, were unable to storm the fire-swept sand-hills in the middle of the English lines.

Menou now ordered his Cavalry to charge, in spite of the strong remonstrances of its leader. The leading squadrons swept through the 42nd, and reached the camp, where their course was effectually stayed by the nature of the ground, and the fire of the Minorca Regiment. As the Squadrons in second line came up, the deployed English battalions, though ridden through, remained firm, and facing about, poured in most destructive volleys, which caused a complete rout.[2]

---

[1] "Afin que les troupes pussent parvenir jusqu'à l'armée Anglaise sans être beaucoup exposées au feu des redoutes et des chaloupes cannonières." "De l'Egypte."—*Reynier*.

[2] The 28th Regiment, on account of the manner in which it bore itself in this battle, was permitted to wear the number of the Regiment on *the back* as well as front of their caps. Sir R. Abercromby received his death wound in this charge.

The battle was virtually over, but a heavy fire of artillery and musketry continued for some time between the opposing armies, when the French gradually retired, covered by the fire of their guns.

The effective force of the English was about 11,500 men, with 300 Cavalry and 36 guns. The French troops numbered 10,000, including 1400 Cavalry and 46 guns.[1] The losses were 1468 killed and wounded on the British side, and that of the enemy may be estimated at about 2000.[2]

The military situation on the day previous to the battle[3] was a somewhat peculiar one. General Abercromby might at any moment be deprived of the assistance of the fleet, and be left in a very precarious position. It was therefore essential to the English that a contest of a decisive character should at once take place. The French, on the other hand, could not afford to wait. The Vizier was marching from Syria, the Indian contingent might at any date appear on the Red Sea, and the field army could not therefore rest inactive at Alexandria. The English, on the whole, could afford delay better than the French, and there seems but little justification for the blame cast on Menou for making the attack of the 21st. The numbers of the combatants were nearly equal, and there was a fair prospect of success.

The plan of attack was in itself good in principle, but so much cannot be said for its details. The English right was the strongest part of the line, and, if attacked, should have been assaulted with all the troops available, the remainder of the line being merely contained by a weak force. As a fact, the French right wing, under Reynier, which was refused, was considerably stronger than the attacking force of Lanusse. The false attack, again, was too weak, and did not in any way deceive the English, or tend to weaken their line. The faulty tactical management of the troops, after the battle had begun, appears due almost entirely to the want of decision and military ability of their leader. Menou attributes his defeat to the want of support he received from his Generals, more especially Reynier. The inaction of the French right does not however explain the lack of unity in the attack, or the reckless misuse of the Cavalry. With regard to the English side, but little can be said. It was a soldiers' battle, and the troops behaved admirably. Reserves were moved up to the only point of attack, but no further movement of troops took place, and no attempt was made to follow up the retiring foe.

The importance of this battle is not to be measured by the number of combatants on each side. Continental nations, accustomed to the combat of great armies, and regarding England only as a naval power, attached but little importance to a contest of so inconsiderable a magnitude. It was, however, the first military success of importance which the English had gained over the soldiers of the Republic, and showed that the British soldier could hold his own against the hitherto

---

[1] "De l'Egypte."—*Reynier.*

[2] 1160 dead were counted on the field. "Expedition to Egypt."—*Walsh.*

[3] The engagement of the 21st is usually called the Battle of Alexandria by the English, and that of Canope by the French.

invincible levies of France. "The Battle of Alexandria not only delivered Egypt from the Republican yoke: it decided, in its ultimate consequences, the fate of the civilized world."[1] To no one was its importance more clear than to Napoleon. The rival power that had destroyed the fleets and commerce of France, was now disputing with success his military supremacy.[2]

The immediate consequences of the victory were not very great. No ground had been gained, and the French still possessed the fortresses of the country, and an army more numerous than the English could bring against them. The losses were very heavy, and the victorious army had to deplore the death of a leader who possessed their confidence.[3] One advantage was at all events secured. The Bedouin Arabs threw in their lot with the winning side, and brought in ample supplies of food to the English markets.

After the failure of the attack on the British lines, the best course open to the French was to leave sufficient garrisons at Cairo, Alexandria, and the forts at the mouth of the Nile, call in all other detachments, and assemble the whole field army in some central position, like Rahmaniyeh, from which it could operate either against the English or the army of the Vizier. But nothing could induce Menou to adopt anything but half measures. The troops were recalled from Upper Egypt, and some 1200 men directed on Rahmaniyeh. Great hopes were entertained of the arrival of Admiral Ganteaume with reinforcements from France, and a despatch boat was sent to inform him of a point on the coast, west of Alexandria, where the troops could be disembarked without fear of molestation.[4]

An attack on Alexandria being deemed out of the question, the English army remained for some days in their bivouacs, repairing their losses. On the 23rd of March, a proposition was made to the French that they should evacuate Egypt and return to France, which was rejected. On the 25th a fleet, bringing 5000 Turks and Albanians, anchored in Aboukir Bay.

General Hutchinson (who succeeded to the command after Abercromby's death) resolved, with the aid of the Turkish contingent, to secure Rosetta and the mouth of the Nile, and thus obtain much needed provisions for the troops, and water for the fleet.

Colonel Spencer, with 1000 men and 8 guns, joined a body of 4000 Turks, and, after a weary march along the sandy shore, occupied Rosetta, without resistance, on the 8th of April. The French garrison of 800 men retired up the Nile, leaving a weak detachment in Fort St. Julien, which surrendered on the 19th. The allied force encamped for some days at El Hamed, and the river was entered by the boats of the fleet.

The facility with which the mouth of the Nile had been captured led

---

[1] "History of Europe."—*Alison.*

[2] "My projects, alike with my dreams, have been destroyed by England."—*Napoleon.*

[3] Sir Ralph Abercromby died on the 28th of March.

[4] Ganteaume started from Toulon on the 22nd of March, but owing to a collision of two of his frigates, put back again to port.

to the conclusion that an advance on Cairo need not longer be delayed. Major-General Coote was left with 6000 men before Alexandria; and, in order to strengthen his position, it was decided to flood the bed of Lake Mareotis. The narrow neck of land which separates the Lakes of Aboukir and Mareotis was cut on the 13th of April, and the water rushed in with such effect that the inundation extended to the westward as far as the eye could reach. The average depth of water was subsequently found to vary from five to eight feet, and a flotilla of gun-boats took post on it, and thus cut off all communication from Alexandria with the interior, except by one circuitous desert route.[1]

On the 24th of April, Hutchinson took command of the troops at El Hamed, and received a promise that the Mamalukes would join him if he advanced on Cairo. The distance from Rosetta to Cairo by river was about 160 miles; there were no roads, and there was practically no land transport. The line of communication was, of necessity, the Nile, and stores and supplies had to be conveyed by a flotilla of boats.

The French, meanwhile, had surrendered the initiative. A small force had been sent to relieve Rosetta, but, arriving too late, had first taken up a strong position at El Afteh, but retired without fighting to Rahmaniyeh, where 4000 men and 33 guns were assembled.[2]

The allied army commenced its advance on the 4th of May[3] in two columns. The main force marched up the left bank of the Nile, while a detachment, some 1600 strong, under Colonel Stewart, crossed to the right bank of the river, and kept pace with it. The total strength of the army was as follows:—

British	Infantry	4,800	
	Cavalry	510	
			5310[4]
Turks and Albanians	Infantry	3,600	
	Cavalry	600	
			4200
	Total		9510 men with 20 field guns.

On the 9th of May, Rahmaniyeh was reached, and the French were found in position. A desultory skirmish took place till nightfall, when the enemy retired on Cairo, leaving behind their boats with large supplies of ammunition and stores. A few days later a convoy of

[1] The damage done was great, some 30 villages being destroyed. Lake Aboukir has now no connection with the sea, and is practically dry. Lake Mariût is still covered with shallow water, and will probably be eventually drained. The isthmus cut through now conveys the railway and the Mahmudiyeh canal.

[2] The strong remonstrances of the Divisional Generals to the course pursued by Menou, led him to arrest Reynier and Damas, and ship them off to France.—*Jomini.*

[3] News arrived that the Turkish Army from Syria, whose co-operation had scarcely been hoped for, had reached Salahieh with its main body, and its advanced guard had occupied Belbeis without resistance.

[4] These numbers are given in "Walsh's Expedition to Egypt," but apparently include the rank and file alone.

70 boats coming down the Menouf Canal to Rahmaniyeh, in ignorance of the state of affairs, were also captured. The English army had now established itself in a central position between the French armies at Alexandria and Cairo, and had for the time severed itself from the investing force in front of the former city. That so important a strategical point as Rahmaniyeh should have fallen with little resistance is a matter which has never been fully explained. The French were certainly outnumbered, but they had a strong position, a superiority in Cavalry and Artillery, and an admirable Infantry force.[1] A considerable portion of the allied force on the other hand was of doubtful value, and their movements for attack were characterized with a slowness and indecision that an active enemy might well have taken advantage of. Thiers has not hesitated to characterize the conduct of the French leader as shameful, while bearing testimony to the admirable condition of the troops.[2]

The allied force marched by easy stages along the river banks towards Cairo. On the 13th of May, General Hutchinson sent to the Grand Vizier, whose army was now assembled at Belbeis, an entreaty to await the co-operation of the English before advancing further.[3] On the 16th, the main body reached Algam and the Menouf Canal, and the following day a large convoy from Alexandria was intercepted in the desert, and surrendered without resistance to a small force of English Cavalry.[4] The camels taken proved of the greatest value to the British. The conduct of the troops guarding the convoy on this occasion was such as to indicate that they would only be too glad to quit the country and return to France.

The presence of the army of the Vizier now began to have an effect on the military operations. The Syrian army of some 16,000 men had hitherto met with no resistance, and on the 30th of April had summoned Cairo to surrender. On the 6th of May a force of 2,500 men was detached to Damietta and Lesbeh, which were evacuated by the French without fighting[5]. In consequence of the impatience of his troops, the Vizier resolved to advance from Belbeis on Cairo, and risk an action without waiting for the co-operation of the English.

When the French troops from Rahmaniyeh entered Cairo, a Council of War was at once called, and the situation considered. The French numbered about 13,600 men, but of these not more than 9000 could be counted on as effective in the field. The fortifications of Cairo were too extensive to be held throughout, the population was disaffected, disease was prevalent, and the stock of money and provisions small.

---

[1] The French troops marched in good order in very hot weather to Cairo, a distance of 83 miles, in four marches—a convincing proof of their condition.

[2] "Consulat et l'Empire."—*Thiers.*

[3] News arrived from Suez that 200 men of the Indian contingent had arrived there the end of April, and found the town unoccupied.

[4] When Menou heard of this surrender, he issued a violent proclamation to his troops, calling it "Une capitulation en rase campagne la plus honteuse qui ait jamais été signée."

[5] The greater part of the garrisons of the "sea forts" were captured by the fleet, while trying to gain Alexandria.

Delay till the combined English and Turkish forces invested the city could only lead to capitulation. The orders received hitherto from General Menou were few and vague, but they all insisted on the importance of the retention of the capital. Only one course appeared likely to lead to success. General Beliard, with a large force of veteran troops, was in a central position to the two advancing hostile armies, which were still too far apart to mutually co-operate. The premature advance of the Vizier, combined with the slowness of movement of the English, gave a good opportunity for defeating the former and dispersing his force. The army of Italy was itself the greatest exponent of the value of "interior lines" in war, and the victors of Dego and Rivoli might well hope that their Generals had not forgotten their cunning. General Beliard determined on an advance towards Belbeis, with a force of 5,500 men, 900 Cavalry and 24 guns. To afford some explanation of this half-hearted movement, French writers have not hesitated to call it a reconnaissance in force, forgetful that as such it could be of little value. The fatal error was committed of not taking the whole of the available field force and striking with energy. The leaving of a large body of troops in Cairo was unnecessary. The population, though disaffected, was cowed, and the possession of the city would necessarily fall into the hands of the victors of a decisive battle.

The French army started from Cairo on the 15th of May, and drove back the advanced patrols of the Turks. The Vizier, impatient to anticipate the attack, pushed forward an advanced guard, composed mainly of Cavalry and guns, while the main body followed up as quickly as possible. After some skirmishing in a wood of date trees at El Hanka, the French moved out in the open in two Infantry squares, with a Column of Cavalry between them. The Turkish force opposed but little resistance in front, but constantly manœuvred to the flanks, and a large body of their Cavalry appeared pushing for Cairo. General Beliard, apprehensive of his retreat being cut off, retired on the capital. The loss was trifling on both sides, but the action was looked upon by the Turks as a victory, and thousand of Arabs in consequence flocked to the banners of the Vizier. The success of the Turks relieved General Hutchinson of much anxiety, and measures were taken for a combined advance on Cairo.

From the camp at Algam, Colonel Stewart, with his detachment on the right bank of the river, was sent along the Menouf Canal to join the Vizier. While the army was halting, orders were sent to Rosetta to order up the Heavy Artillery and forward all possible supplies. The sickness of the troops was daily increasing; no pay had been received for four months, and the weather was very trying. On the 31st May, Osman Bey, with 1500 Mamalukes, joined the British camp.

The long expected division of Indian troops might be now daily looked for, and it was impossible to delay any longer. General Hutchinson, after ordering up two additional Regiments from Alexandria, moved again forward on the 1st of June. The Turkish army, after their fight at El Hanka, struck southwards to the Damietta branch of the Nile, and the two armies advanced on a level

front towards Cairo, the vicinity of which was reached on the 16th of June. A bridge of boats was thrown across the river at Shubra to connect the two armies, and a partial investment of the city took place.

The position of the French General was now a difficult one. The fortifications of the city were too extensive to be defended throughout by the troops, and were too weak to withstand the assault of a European army. The investing force amounted to 30,000 men, and would shortly be increased by the arrival of General Baird's contingent from India. The inhabitants of Cairo were disaffected, supplies were beginning to run short, the garrison itself was discontented, and there seemed no hope of assistance from Alexandria. It was well known that the main object of the English was to secure the evacuation of Egypt, and their slowness of movement and hesitation might well be attributed to a desire to avoid a fight if possible. Capitulation seemed inevitable, and the sooner it took place the more favorable would be its terms.[1] A conference to consider the terms of surrender was demanded by General Beliard on the 22nd June. On the 27th a convention was signed, by which the French army, and its dependants, were to march to Rosetta with its arms, baggage, Field Artillery and ammunition, and be conveyed by the most expeditious route to the French ports on the Mediterranean. The penultimate clause of the convention was to the effect that the army of Alexandria might, if they wished it, accept of the same terms.[2]

The citadel, guns, and fortifications were handed over, and the army of the Vizier occupied the city. The march to Rosetta commenced on the 15th of July, the Turks leading, followed by the British under General Moore, while the French brought up the rear.

A march of so extraordinary a character has never before been made. Two victorious armies escort a third, who are not in any sense prisoners, to the port of embarkation, and see that they are dispatched, free of expense, to their own country!

Three hundred dgerms conveyed the French sick and baggage, and at their head was a vessel drooped in black, containing the body of Kléber, from which was directed the daily march and halt, by the firing of a gun. On reaching Derout, the French troops were allowed to pass to the front, and the disembarkation which took some days, was finally completed on the 7th of August.[3]

To return to the operations of the force before Alexandria after the departure of the main body to Rosetta.

The blockading army, under the command of General Coote, consisted of about 8000 men, besides a large number of sick.[4] Three unsuccessful attempts had been made by Ganteaume to carry reinforcements to Alexandria, and both armies contented themselves in strengthening their positions. On the 20th of June, the French made a cut in the canal, with a view of flooding the left front of

[1] The official report of General Beliard states the circumstances of the case fairly, and in moderate language. "Expedition to Egypt," App. 18.—*Walsh.*

[2] The text of the convention, which was similar to that of El Arish, is to be found in *Walsh.*

[3] 13,672 soldiers and 82 civilians were shipped.

[4] *Vide* Parade State of 25th April, App. 10.—*Walsh.*

the British lines, and thus contracting the area of a possible attack. With great labour, a dam, parallel to the canal, was erected across the low ground, and checked the inundation. Early in July reinforcements arrived from England, and on the 9th of August the leading troops of the army of Cairo put in an appearance. General Hutchinson having now some 16,000 effective men (exclusive of Turks) under his command, determined on besieging Alexandria on both the eastern and western fronts. A strong force of gun-boats was pushed into Lake Mariût, while all the available small boats were collected for transporting the troops. The arrival of the Indian contingent of General Baird in Upper Egypt being reported, he was ordered to proceed by water as rapidly as possible to Rosetta.

On the evening of the 16th, the boats were assembled on the inundation close to the English lines, and a force of some 4000 men, under General Coote, embarked. The flotilla started about 9.30 p.m. Early next morning it was found that about half the boats, owing to a change of wind, had drifted to leeward, and it was not till 10 a.m. on the 17th that they could be assembled and pushed for the shore. The point at which General Coote intended to disembark was apparently guarded by a small force, and, leaving a Brigade to occupy its attention, the main body sailed some two miles further west, and disembarked without opposition. Measures were at once taken to dig for water, and lay siege to Fort Marabout, an isolated post due north of the place of landing. A combined military and naval attack was made on this fort, which, after two days, surrendered. The French, meanwhile, had taken up with a comparatively small force a position on the sand-hills across the isthmus. Seven sloops of war were pushed into the western harbour of Alexandria; and, aided by their fire and that of the gun-boats on the inundation, General Coote advanced in three columns, and totally routed the enemy, who did not make any serious resistance. A position some 1400 yards from the most advanced works was thus gained. A successful night attack on the 25th drove in the French outposts, and the siege guns were brought into position some 600 yards from the redoubts, Des Bains and Leturcq. The city was now effectually surrounded, and all supplies cut off. There appeared no hope of obtaining succour from France, as Admiral Gantheaume had failed, after three attempts, to land reinforcements, and Menou, with the consent of his officers, agreed to capitulate.

A convention was signed on the 2nd September by which the city, its guns, stores and garrison surrendered on the condition that the latter should be conveyed to France.[1] After the reduction of Alexandria the greater part of the army returned to England, leaving a garrison of 5000 men to occupy the country till peace was signed. The total British loss in the campaign amounted to 550 killed and 3058 wounded.

The capitulation of the French army in Egypt was the sole great disaster which the Republicans had hitherto experienced by land, and every effort has been made by the historians friendly to their cause to

[1] The garrison consisted of 10,528 soldiers and sailors, and 685 civilians.

detract from the credit due to the English troops. On the other hand, it was the first occasion on which the British military forces had shown their ability to cope with the formidable levies of modern France, and the deductions of the self-complacent national annalists must be received with some reserve. The allied armies which landed in Egypt were, numerically, superior to the defenders of the country; but numbers do not always constitute strength. If the English had been defeated, there was little doubt that the Turks would not fight single-handed, and the true issue lay on the result of a combat between two practically equal armies. In the words of Napoleon himself:—"The English disembarked an army of 18,000 men without Artillery or Cavalry horses: it should have been destroyed. The army, vanquished after six months of false manœuvres, was disembarked on the shores of Provence, still 24,000 strong."

The main cause of the French defeat appears to have been the faulty strategy and military incapability of Menou. He was the senior General of the army, but was wanting in strength of character, and "a doubt hung over his military capacity."[1] With several capable leaders to choose from, it is difficult to understand how Buonaparte—a good judge of men—appointed him to a command so onerous. It has been customary to attribute to him considerable administrative ability as a civil governor, but a recent writer shows that even this is doubtful. He tried to "organise" the colony by upsetting all existing arrangements, and founding a new fabric based on innumerable decrees and regulations. An elaborate system of French law and fiscal duties was unsuited to a semi-civilized oriental race; but Menou had, in common with many of those who colonize with narrow views, a belief that civilization meant assimilation with the mother country. A master of forms and ceremonies, a lover of the petty minutiæ of the office table, he does not appear to have been capable of rising above the ordinary mediocrity of the red-tape official.[2]

Whether the reproaches of Napoleon against Gantheaume were well founded or not it is difficult to say. The superiority of the English fleet was unquestionable; but a careful reading between the lines of any account, French or English, of the three attempts to get across the Mediterranean, would appear to show that some troops could have been landed if more determination had been displayed. Whether the reinforcements thus brought would have materially affected the ultimate result is doubtful.

Reference has before been made to the defective *morale* of the French troops and their intense desire to again get back to their own country. There can be no doubt they felt acutely the departure of Buonaparte, and though Kléber was popular, his successor was the very reverse. No further glory could be gained in Egypt, and there was little inducement for the French soldiery to expatriate themselves for the purpose of founding a colony for the benefit of others. Distrustful

---

[1] Napoléon.

[2] "Il mit en toute chose le désordre et la desorganisation qui existaient dans sa cervelle détraquée." Histoire de Napoléon.—*Lanfrey*.

of their commanders, and heartily sick of the evanescent "glories of the East," it was not wonderful that their fighting was, on occasions, half-hearted.

The landing on the open beach of Aboukir Bay, in the face of a determined enemy, was an operation that reflected the highest credit on the General who planned it, and the soldiers and sailors who carried it out. That such a brilliant success should be followed up by a cautious and hesitating advance seems almost inexplicable. A rapid movement along the isthmus would probably at once have carried Alexandria, or at all events secured the position afterwards gained with great loss on the 13th of March. The advance on Cairo was undoubtedly sound, but it was *two months* before Rahmaniyeh was reached. That such unreasonable delay was not fatal to success is due to the faulty strategy of Menou, and its cause has never been clearly explained.[1] The conveyance of the French field force, intact, to France, with their arms and equipment, when they could, without doubt, have been made to surrender unconditionally, showed tolerably well the anxiety not to push matters to an extreme limit, or hazard a combat *à outrance*.

The Indian contingent, to which reference has been frequently made, did not arrive on the theatre of war in time to take part in the campaign. It will not, however, be without interest to sketch briefly its progress. The object of the landing in the Red Sea was,—firstly, to dispossess the French of Suez, Cosseir, and any ports they occupied on the coast; secondly, to encourage the native population of Upper Egypt to commence hostilities; and thirdly, to aid the operations of the natives by joining with them the whole or part of the Indian troops.

Instructions as to despatching the expedition were not received in Calcutta till the 6th of February. It happened, however, that troops and supplies had for some time been collected for the purpose of capturing Batavia and the Mauritius, and a force was thus immediately available for active operations. General Baird was given charge of the expedition, with Colonel Wellesley as his second in command.[2] The transports having assembled at Bombay, sailed by small divisions across the Indian Ocean to Jedda, as the intricate navigation of the Red Sea rendered it difficult to handle a large fleet. The first division started at the end of March, arrived at Jedda on the 28th of April, and landed the troops at Cosseir on the 21st of May, when the place was found to be abandoned by the French. It was the original intention to proceed to Suez, but the monsoon had set in and it was found impracticable to beat up so far. At Cosseir a camp was formed, and troops continued daily to arrive both from India and the Cape up to the 10th of July. The total number which eventually landed amounted to some 6,400 men, of whom 2,700 were sepoys (exclusive of camp

---

[1] Napoleon in 1798 was at Rahmaniyeh 8 days after landing, and fought the Battle of the Pyramids ten days later. The English took 63 days to reach Rahmaniyeh, and 40 more to gain Cairo.

[2] Colonel Wellesley (afterwards Duke of Wellington) was left behind at Bombay on account of illness.

followers). The bulk of the force was composed of five Battalions of English troops, and three of Natives. Besides these, there was one Squadron of Cavalry, a small force of Artillery drawn from the three Presidencies, and some 2,000 native camp followers making a grand total of over 8,000 men. The transfer of so large a force across 140 miles of desert was an operation demanding much care and forethought. Both General Baird and Colonel Wellesley agreed that it would be madness to attempt it unless the Mamalukes were favorable to the English cause.[1] Not only had transport to be collected, but the subsistence of the army, when it gained the Nile, had to be considered, as well as the amount of resistance that might be offered by the French. The situation was made tolerably clear in the middle of June by a letter received from General Hutchinson, in which he stated that he was about to invest the French garrison in Cairo, and that the Mamalukes and country people had thrown in their lot with the English. Some 5,000 camels had already been collected, and it was decided to march at once by detachments from Cosseir to Keneh, where the whole force was to be assembled. The heat was very great, the stages were long, and at some of the halting places there was no water. By means of the camels supplies could, with care, be deposited at different points, but the carriage of water presented some difficulty. Large casks were first used, but found to leak so much as to be useless. But few water kegs were available, and the main dependence was placed on well-greased massaks. At all halting places where water was procurable, numerous wells were dug, and a supply of two gallons was carried for each soldier to camps where there was no water, the camels then returning for more. After the route had been traversed by Staff Officers, and preliminary arrangements as to water and supplies made, the army started by detachments on the 21st of June, and, marching at night, reached, in eight stages, Keneh, when the whole force was assembled at the end of July.[2] Instructions were now received from General Hutchinson to proceed at once to Cairo. The Nile was rising very rapidly, and it was evident that the army must either be conveyed by water, or march by a desert route; a large number of dgerms were collected, and the bulk of the force was embarked. The 10th Regiment marched by land as far as Girgeh, but finding boats available there, took to the water. The troops, who had been aided in every possible way by the Arabs, arrived at Cairo on the 7th of August, and at the end of the month sailed down the river to Rosetta. Arriving too late to take part in the fighting, the Indian contingent proved of service in garrisoning the country until a stable government was established. In May, 1802, the troops concentrated at Cairo, and, crossing the desert to Suez in five days without much difficulty, re-embarked for India.[3]

---

[1] "I am decidedly of opinion that if the Mamalukes are not on our side, no attempt should be made to cross the desert."—*Memorandum forwarded by Colonel Wellesley from Bombay.*

[2] With a loss of only *three* men.

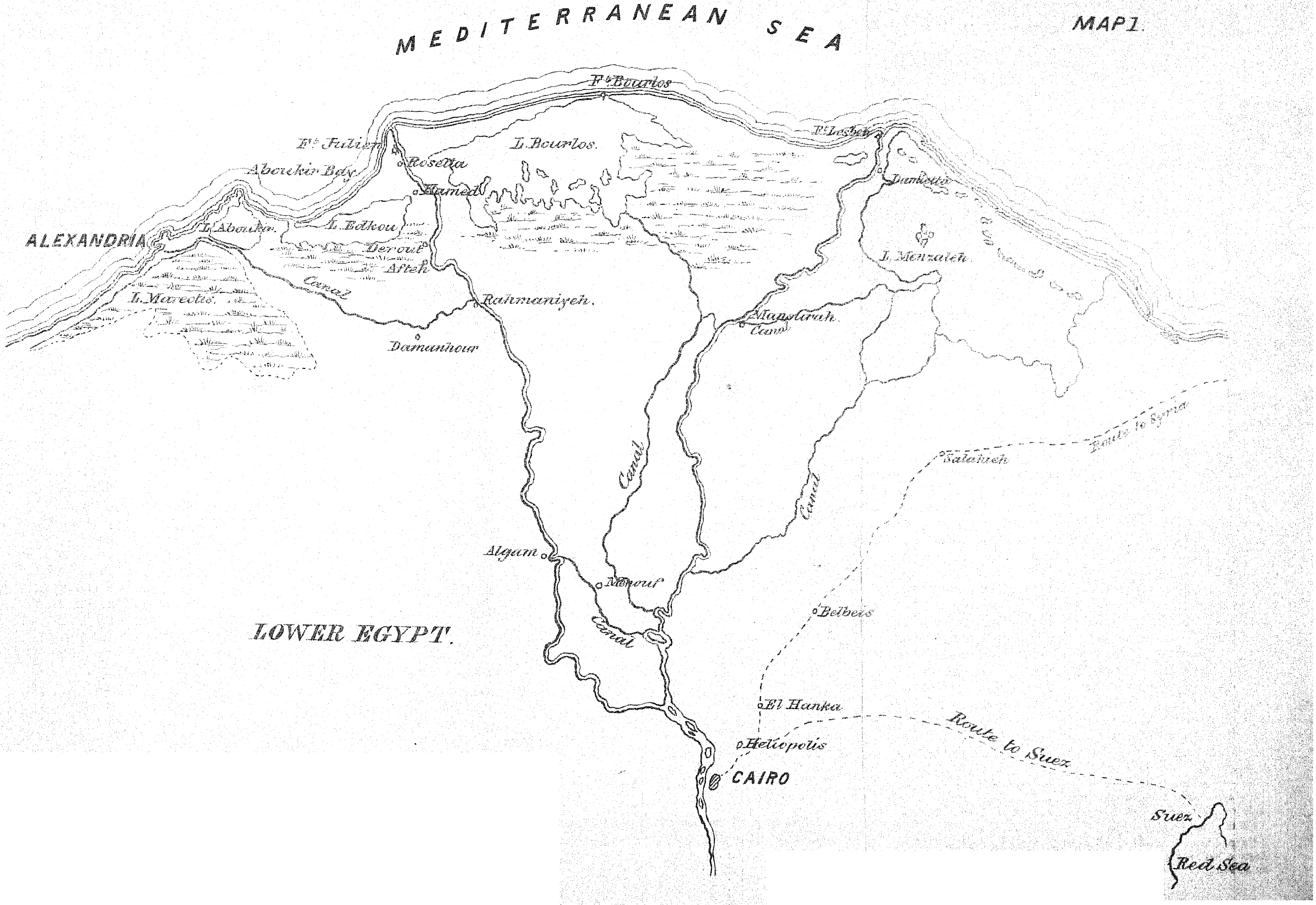
[3] A good non-official account of the march is to be found in the "Mémoire relatif à l'Expedition Anglaise."—*Comte de Noé.* While interesting orders and memoranda are inserted in the Life of Sir D. Baird.

followers). The bulk of the force was composed of five Battalions of English troops, and three of Natives. Besides these, there was one Squadron of Cavalry, a small force of Artillery drawn from the three Presidencies, and some 2,000 native camp followers making a grand total of over 8,000 men. The transfer of so large a force across 140 miles of desert was an operation demanding much care and forethought. Both General Baird and Colonel Wellesley agreed that it would be madness to attempt it unless the Mamalukes were favorable to the English cause.[1] Not only had transport to be collected, but the subsistence of the army, when it gained the Nile, had to be considered, as well as the amount of resistance that might be offered by the French. The situation was made tolerably clear in the middle of June by a letter received from General Hutchinson, in which he stated that he was about to invest the French garrison in Cairo, and that the Mamalukes and country people had thrown in their lot with the English. Some 5,000 camels had already been collected, and it was decided to march at once by detachments from Cosseir to Keneh, where the whole force was to be assembled. The heat was very great, the stages were long, and at some of the halting places there was no water. By means of the camels supplies could, with care, be deposited at different points, but the carriage of water presented some difficulty. Large casks were first used, but found to leak so much as to be useless. But few water kegs were available, and the main dependence was placed on well-greased massaks. At all halting places where water was procurable, numerous wells were dug, and a supply of two gallons was carried for each soldier to camps where there was no water, the camels then returning for more. After the route had been traversed by Staff Officers, and preliminary arrangements as to water and supplies made, the army started by detachments on the 21st of June, and, marching at night, reached, in eight stages, Keneh, when the whole force was assembled at the end of July.[2] Instructions were now received from General Hutchinson to proceed at once to Cairo. The Nile was rising very rapidly, and it was evident that the army must either be conveyed by water, or march by a desert route; a large number of dgerms were collected, and the bulk of the force was embarked. The 10th Regiment marched by land as far as Girgeh, but finding boats available there, took to the water. The troops, who had been aided in every possible way by the Arabs, arrived at Cairo on the 7th of August, and at the end of the month sailed down the river to Rosetta. Arriving too late to take part in the fighting, the Indian contingent proved of service in garrisoning the country until a stable government was established. In May, 1802, the troops concentrated at Cairo, and, crossing the desert to Suez in five days without much difficulty, re-embarked for India.[3]

---

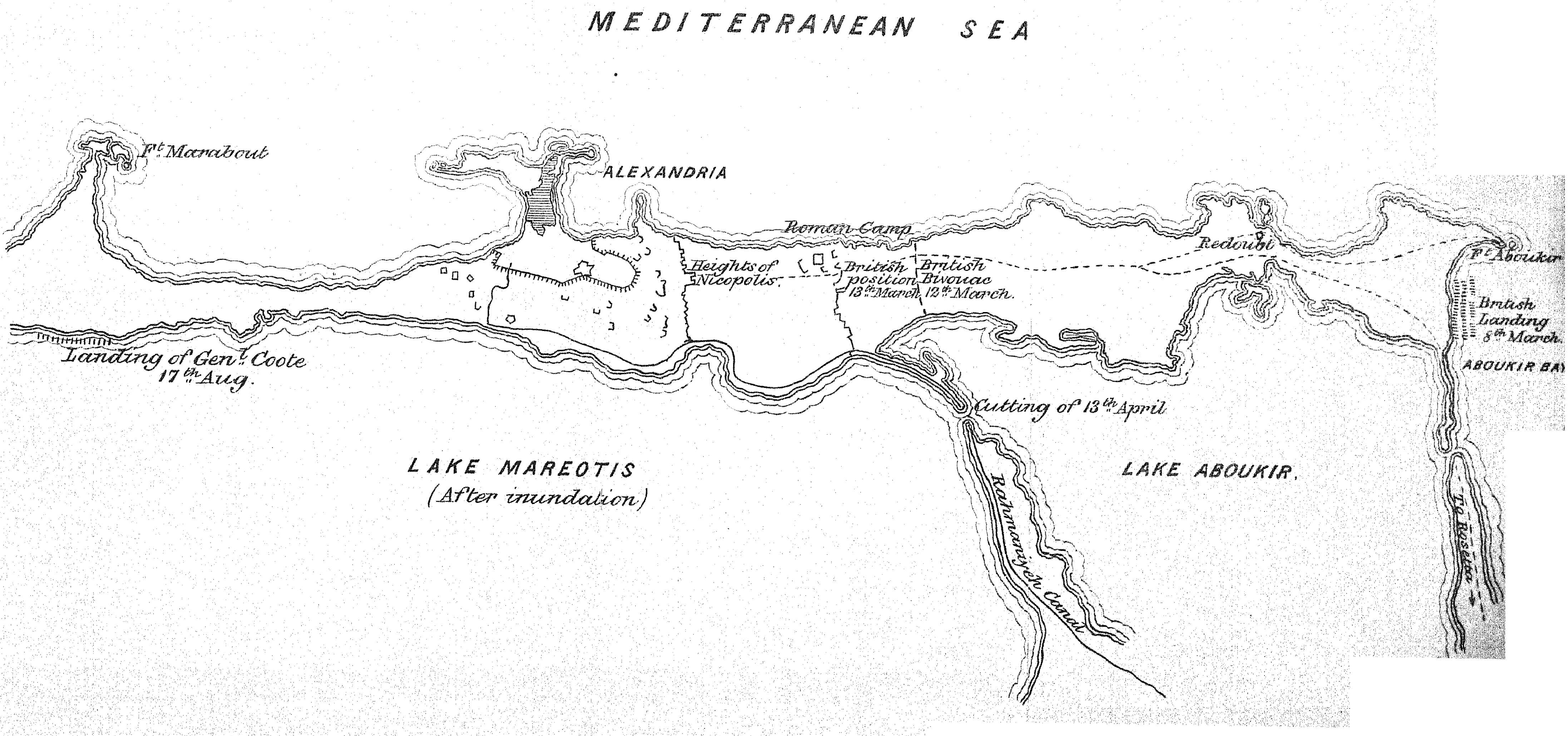
[1] "I am decidedly of opinion that if the Mamalukes are not on our side, no attempt should be made to cross the desert."—*Memorandum forwarded by Colonel Wellesley from Bombay.*

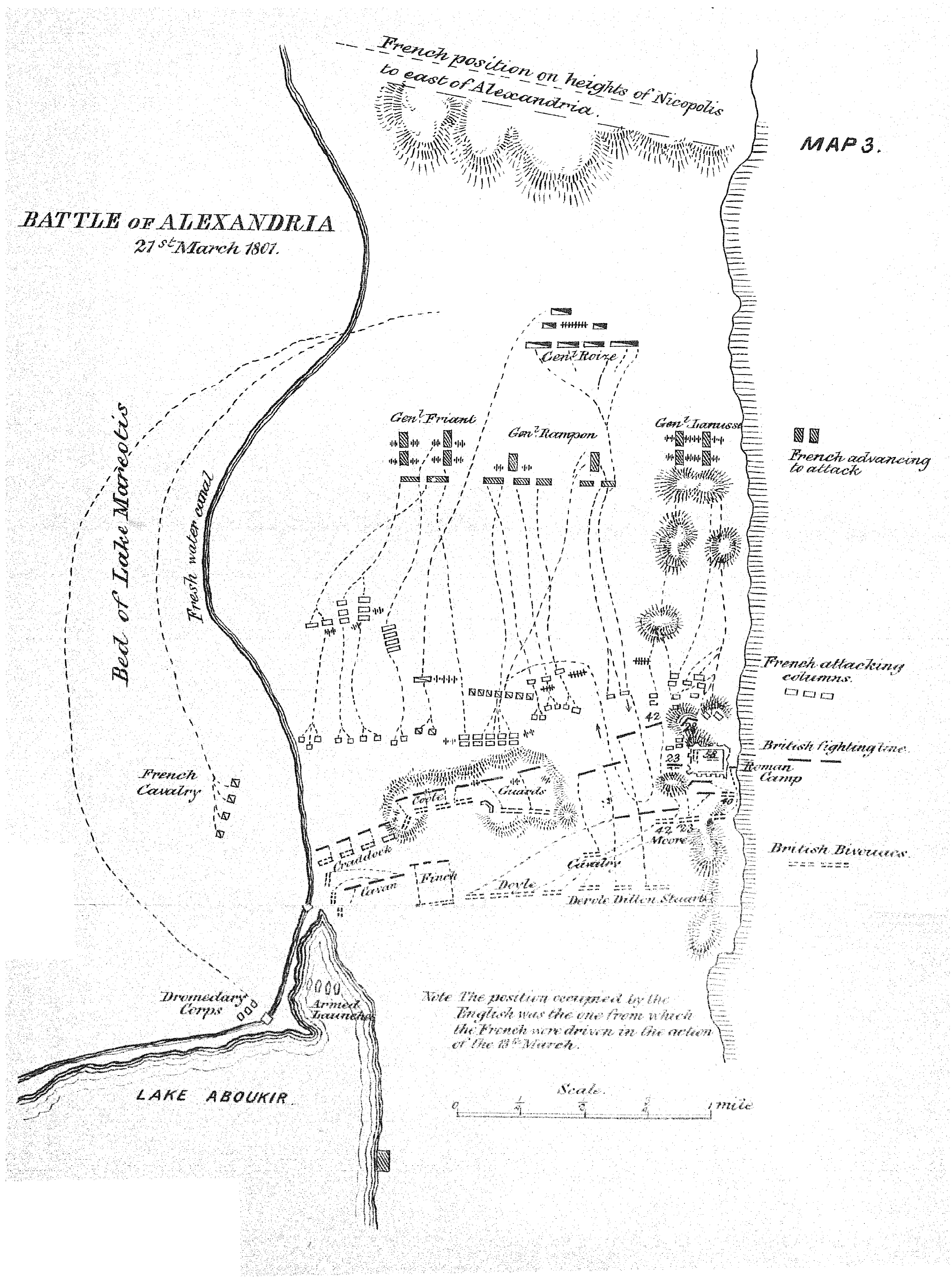
[2] With a loss of only *three* men.

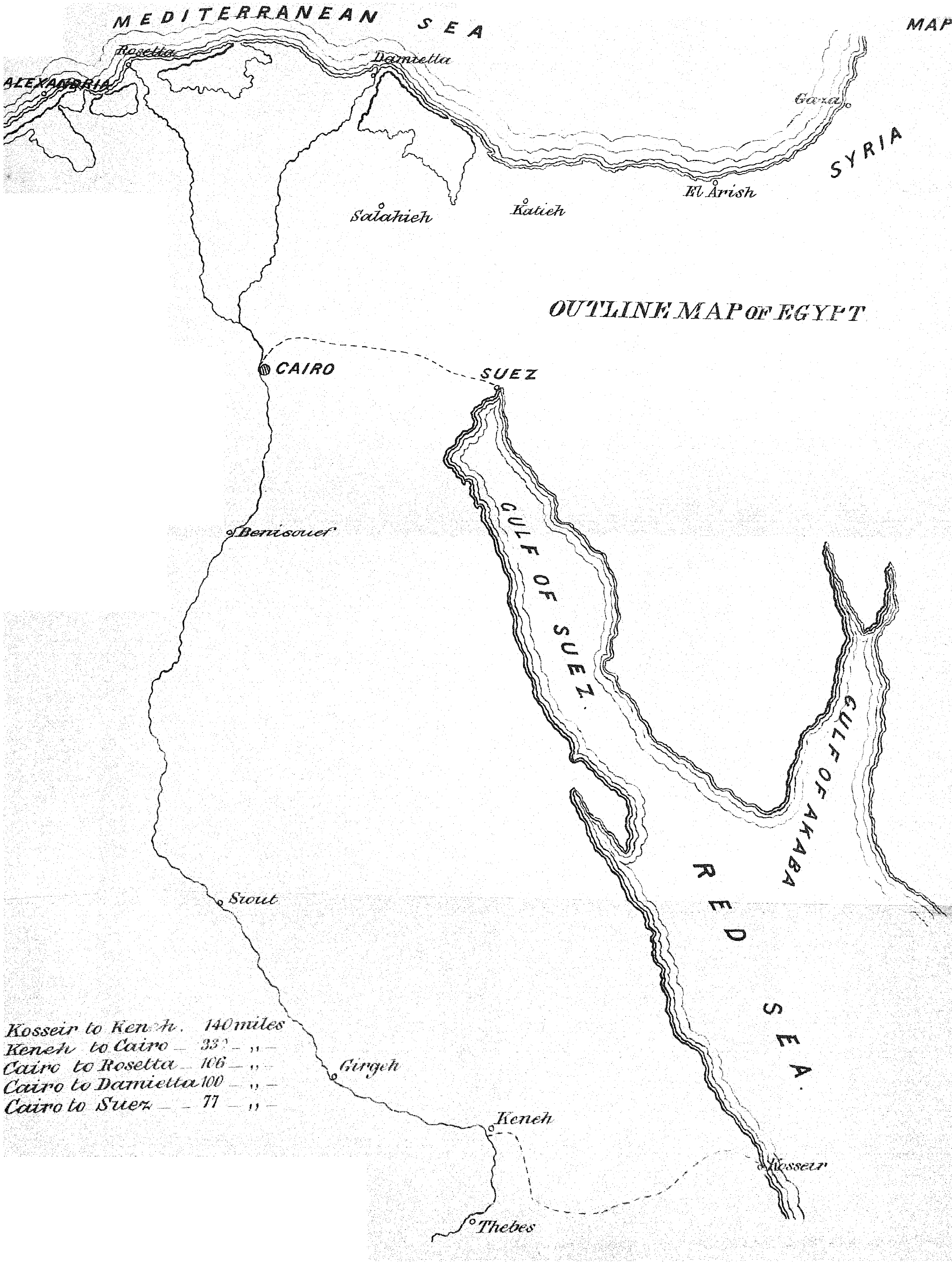

MAP 1.
MEDITERRANEAN SEA
Ft. Bourlos
Ft. Julien
Ft. Lesbeh
L. Bourlos.
Rosetta
Aboukir Bay.
Hamed
Damietta
ALEXANDRIA
L. Aboukir.
L. Edkou
Derout
Afteh
L. Menzaleh.
Canal
L. Mareotis.
Rahmaniyeh.
Mansourah.
Damanhour
Route to Syria
Salahieh
Canal
Canal
Algam
Menouf
Belbeis
LOWER EGYPT.
Canal
El Hanka
Route to Suez
Heliopolis
CAIRO
Suez
Red Sea

ALEXANDRIA & ABOUKIR.

MAP 2.




MAP 3.
BATTLE OF ALEXANDRIA
21st March 1801.
French position on heights of Nicopolis to east of Alexandria.
Genl Roize
Genl Friant
Genl Rampon
Genl Lanusse
French advancing to attack
Bed of Lake Mareotis
Fresh water canal
French attacking columns.
British fighting line.
Roman Camp
British Bivouacs.
French Cavalry
Guards
Coote
Craddock
Cavan
Finch
Doyle
Moore
Cavalry
Dromedary Corps
Armed Launches
LAKE ABOUKIR.
Note The position occupied by the English was the one from which the French were driven in the action of the 13th March.
Scale.
0 ¼ ½ ¾ 1 mile
42
23
58
40
28


OUTLINE MAP OF EGYPT
MEDITERRANEAN SEA
SYRIA
Alexandria
Rosetta
Damietta
Gaza
El Arish
Katieh
Salahieh
CAIRO
SUEZ
GULF OF SUEZ
GULF OF AKABA
RED SEA
Benisouef
Siout
Girgeh
Keneh
Thebes
Kosseir
Kosseir to Keneh. 140 miles
Keneh to Cairo
Cairo to Rosetta 106 „
Cairo to Damietta 100 „
Cairo to Suez 77 „

The march from Cosseir to Keneh by General Baird is the first recorded instance of a European army, with its Artillery and numerous incumbrances, crossing an Eastern desert. The lessons to be learnt from it are the more impressive, as they are emphasized by the experience of some 200 men at an earlier period in the year, who crossed from Suez to El Hanka, and nearly perished on the march.[1] The main difficulty to contend with is the water supply; and when wells are wanting, an ample amount must be carried on camels in bags of skin, dressed with some oily substance, to prevent their cracking. Troops must not march in too great numbers, and water should be found with certainty, in advance, before a march is made, from existing wells. The difficulty of heat is partially obviated by marching at night, and resting under tents by day; care should be taken to have ample covering when resting at night, when the dew is sometimes heavy. Tea was found to be an admirable restorative, but coffee or cocoa is probably even better. Camels are an absolute necessity for the conveyance of supplies and stores, and a large number should be available to carry sick and exhausted men. The difficulties of a march are enormously increased if there has to be any fighting for the wells, and every effort should be made to secure the friendship of the Arab tribes that hold the route.

---

[1] A detachment of the 86th, under Colonel Lloyd, which arrived at Suez in April, 1801, and afterwards joined the army of the Vizier before Cairo.—"Expedition to Egypt."—*Wilson.*

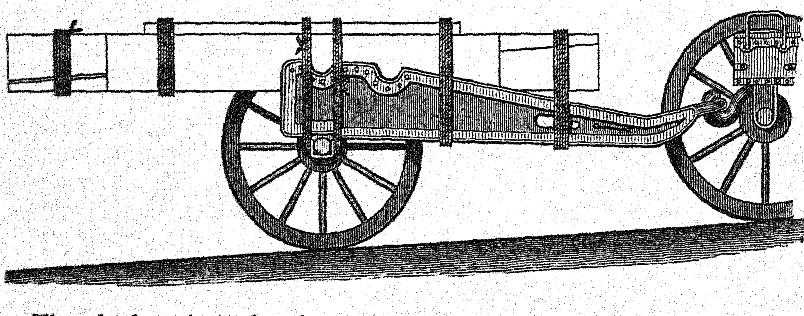
METHOD OF CARRYING A CLERK'S PLATFORM.

BY

LIEUT. M. S. C. CAMPBELL, R.A.

In the recent siege manœuvres carried out by 5/1 Southern and 4/1 Lancashire Divisions, at Roorkee, a Clerk's platform was packed for marching, under the supervision of Lieut. Parker (5/1, S. D.), upon a spare gun carriage. The carriage was for 6·3-in. howitzer or 40-pr. The platform was a Mark I. with two transoms and two sleepers and a trail plank.

The side-pieces, with the sleepers *between* them, and transoms, &c., outside, were securely lashed to the carriage, as shewn in the sketch; all the small stores, such as stops, pivot pins, &c., were put inside the limber.



The platform is 15 feet long, and was so arranged that about 8 feet of it projected over the *axletree* of the carriage, and the remaining 7 feet were lashed to the trail; this gave a very fair balance, as near as possible in proportion to that of a 40-pr. mounted on the carriage.

It travelled perfectly and, in spite of the rotten lashings that were procured, did not lurch or shift at all, although some fairly rough ground was travelled over.

BATTLE FIELDS

IN THE

LE MANS CAMPAIGN.

BY

CAPTAIN R. F. JOHNSON, R.A.

No. 3.

ST. AMAND DE VENDÔME.

On the morning of the 6th January, 1870, the left of the German force, commencing to move against General de Chanzy's army, was near St. Amand, a village about 8 miles south of Vendôme. A French force of about 10,000 Infantry, 800 Cavalry, and 24 guns, under General Curtin, was near Chateau-Renault, a town 16 miles from Vendôme in the same direction. The French had orders to march on Vendôme, to support General Jouffroy's advance from the west.

The whole country round St. Amand is so flat that it is difficult to find any point of vantage; a horseman can see twice as far as a man on foot, and a ladder against a telegraph post would constitute quite an observatory.

The village stands on a slight ridge, stretching along each side of the Herbault (S.E.)-Lavardin (N.W.) road. To the south is a glacis-like slope of about 300 yards, and the ground is quite open, but on the right small woods lie close to the buildings on the west side of the railway. To the S.E. and E. the view is limited by large woods distant about 2½ miles. From the bottom of the glacis the ground rises gently to the south as far as a line running east and west through the small farm of Les Homas, 2200 yards from St. Amand.

The Brenne brook commences just W. of the village, and passing under the railway runs S.W. to Villethion (Vilthiou in the translation of the German official account), receiving on its way a few very small watercourses draining the ground to the west as far as the Vendôme-Chateau-Renault main road. As far as Villethion the brook is insignificant, and no obstacle except in very wet weather, when its marshy sides become very soft; but at Villethion the valley or course is about 30 feet deep, and its sides being covered with gardens and small enclosures, it becomes an obstacle to Cavalry and Artillery. The main

road crosses on a broad stone bridge and there is a ford on its west side. The water is about one foot deep in wet weather.

South of Les Homas farm the ground east of the Brenne brook falls as far as a line through Villeporcher, and then rises to a well-defined but low ridge, whose crest runs from the north end of the Chateau-Renault forest through Neuville. West of the Brenne brook the country is level, and becomes more and more enclosed until considerable woods are met with west of Villechauve.

To visit the ground go to Villechauve by train. On leaving the station cross the rails and gain the main road, then turn to the left (N) and follow the road until the level crossing is reached, whence keep on the east side of the railway across the fields to a slight knoll which lies between the railway and Les Haies; this is about the highest point of the battle-field and in the middle of the fight.

Face south-west. On your right front is Villechauve, a compact village (460 inhabitants) in the shallow valley of the Brenne brook. In front of you, a little over 2000 yards off on the left of the main road, is the small farm of La Garonnière, close to which on the other side of the road is a small depression full of scrub wood; beyond, distant $2\frac{3}{4}$ miles, is the ridge covering Chateau-Renault. On the left front is the forest almost reaching forward to the village of Villeporcher (300 inhabitants) 3250 yards on your left. Two miles beyond Villeporcher is St. Cyr-du-Gault (500 inhabitants) hidden by the surrounding trees. Close by you is the small collection of buildings, Les Haies; and 2 miles off to the left rear is St. Gourgon (250 inhabitants) with its conspicuous black belfry; this village is about 3250 yards from Villeporcher, and 2200 yards from the hamlet of Pias, which lies between them. Villethion is 1500 yards away on the right rear, hidden by trees in the valley of the Brenne, in which also can be seen the church spire of Longpré, the same distance on the right. The country is quite open to St. Amand, just over 3 miles to the rear: but that village is partly hidden by the low flat ridge running through Les Homas, 3250 yards from you.

At 9 o'clock on the cold morning of the 6th of January, 1870, the Germans had a Battalion and 4 Squadrons spread as outposts between Villethion and Villeporcher, and 2 Battalions, 5 Squadrons, and 6 guns near St. Amand. Other troops were moving westward in rear, and these were to follow as soon as relieved by some Cavalry coming from the north-east. But as the mist cleared away and the day became bright, strong bodies of French were seen advancing all along the line from Villechauve to St. Cyr-du-Gault, a front of 7000 yards; and, to prevent the bodies moving westward, being taken unexpectedly in flank, and to secure their own retreat, the German outposts had to make rapid dispositions for holding their ground.

The French advance with resolution, as well they may, and the Germans soon find that 3000 yards of front is not to be held by a Battalion. By 9.30, the French have begun to turn the left from Villeporcher, whence the Germans have retired to Pias. The former, however, do not move quickly as was once supposed to be their characteristic, and the latter make a stubborn resistance, as might be

expected. Nevertheless, by 10.30, the French have pierced the centre of the line, and captured Les Haies; they have guns in action, and all seems going well for them.

At 11 o'clock the battle again recedes southward, for 9 Squadrons and 6 guns have arrived at St. Gourgon and checked the French right, while half a Battalion supported by 6 guns has, leaving another half a Battalion near Villethion, advanced by the Vendôme road and recaptured Les Haies, on which the guns have galloped up and opened on the retiring foe from your knoll.

A pause now ensues, but soon the French, having gained fresh strength, again advance; and their enemies, to avoid being outflanked on both wings, have to withdraw their left to St. Amand, their right behind the Brenne brook at Villethion; their Battery by you is the last to leave, and its place being quickly taken by some French guns.

The tide of battle passes on northward, and must be followed.

At 1 p.m., 12 German Squadrons arrive at Les Homas, but can do nothing in this open plain against the well-armed Infantry.

The Germans converge on St. Amand steadily (followed by the French), and at 2.30, all the Infantry that have been brought up are near the village, supported by large bodies of Cavalry that have been continuously arriving since noon. These horsemen are distributed as follows, but can only give moral support:—9 Squadrons on the right flank, 17 on the left, and 4 in rear of the centre, while the 12 which moved to Les Homas have been sent to Prunay, 2 miles westward, to protect the rear of columns marching west by Lavardin.

Things are none too promising for the defence, when at 3 p.m., a welcome reinforcement arrives in the shape of 3 Battalions and a Company of Pioneers, who, having passed westward through St. Amand before affairs became serious, have been hastily recalled from St. Ambloy, a village 2½ miles to the north-west. This reinforcement brings the German strength up to 6 Battalions, 1 Company of Pioneers, 42 Squadrons, and 18 guns. The Squadrons and guns hover in rear and on the flanks, eager for a chance to roll up the long line of attackers—a chance which never comes—while the Infantry are distributed along the long street of houses forming the village of St. Amand, all well constructed buildings with a natural glacis to the front; 1½ Battalions are in the western part, 4 Battalions in the new part of the village about the railway station, and half a Battalion and 1 Pioneer Company at the cross roads, a mile to the west, on the direct route to Vendôme.

The fight again slackens, and, in fact, almost ceases, for a front attack is not a pleasant undertaking with such favourable circumstances for the defence; but the French are numerous, and can afford to detach largely to a flank. After an interval large bodies issue from the woods to the east, and advance on the village; the east end is rather hastily evacuated without the attack being waited for, and this necessitates the abandonment of the part near the station.

The Germans retire, and the French, satisfied with the success they have obtained, do not pursue.

The German Infantry bivouacs at Huisseau-en-Beauce, 2½ miles to the

north; the Cavalry, towards Prunay, is reinforced, and 16 Squadrons are sent to Villeromain to the N.E., to watch the main road from Blois to Vendôme.

The French bivouac at St. Amand, but retire again, for unexplained reasons, early on the 7th.

On the 7th the day is damp and foggy. The Germans, strongly reinforced from the west, advance at 10 a.m., along the main road towards Chateau-Renault.

With some close fighting in the fog they capture Villechauve, La Garonnière farm, and Pias, and in the afternoon continue the fight round various farms near Villechauve, while 12 guns, from a point close by the level crossing just north of Villechauve station, shell strong French columns moving westward.

On the 8th, all offensive action being apparently abandoned by the French, most of the German troops again march westward; but a considerable force is left to guard Vendôme and the communications from any attacks emanating from Chateau-Renault, and is thus deducted from the numbers available for the encounter with General de Chanzy's formidable Army round Le Mans.

Return to Vendôme by train from St. Amand. Huisseau-en-Beauce, a beautifully situated village, is seen on the left (W.) just where the railway crosses the Chateau-Renault road.

(*To be continued.*)

GENERAL GORDON

ON THE EMPLOYMENT OF

ARTILLERY IN IRREGULAR WARFARE.

COMMUNICATED, BY PERMISSION OF SIR HENRY GORDON, K.C.B., BY

COL. W. H. GOODENOUGH, R.A.

Introduction.

What are the conditions which should govern the employment of Artillery in savage warfare?

This is a question which has been before us recently, and the answer practically given appeared, if we are at all correct judges of opinion, to bring rest neither to aspiring artillerists nor to military critics in the press.

The force of Artillery in the Soudan expedition—eight guns at first, and twelve later—was, doubtless, both a weak and a small one. Would a larger force have been profitably employed? Above all, would it have been advantageous to have sent thither a battery of Horse Artillery, as was so strongly urged in the columns of the leading paper? If there is, as we believe, a considerable tendency in our Artillery service to reply to such questions affirmatively, can that tendency be justified by argument? Is it based on reflection and experience, or on professional prejudice?

Believing that the whole question has not been "thrashed out" sufficiently, we have ventured in these few lines to raise it, and by way of text for our discourse, and for possible further discussion, to lay before our readers the opinion of General C. G. Gordon as it was given to the Cape Government about two years prior to his present employment in the Soudan.

This opinion, coming from one who has had so wide an experience, will doubtless be held to have much weight, and to be deserving of wider publication than it has as yet enjoyed through the medium of a Colonial Blue-book and a professional paper (Royal Engineers) printed for private circulation.

General Gordon's advice to his then employers of the Cape Government must have had reference to wars in Basuto and Kaffirland chiefly, and can hardly be deemed conclusive as to savage warfare in all its conditions. Would he, for instance, apply the term guerilla warfare

he so frequently uses to the action of the Zulu "Impi"? Nevertheless, as an opinion which has become more or less known, and which is, whether by earlier or later-formed judgment, shared by others to an important degree, it deserves most careful consideration and sifting.

Having faith in our Arm, and the desire that others, in and out of our Artillery service, should equally have that faith, surely we are right in thinking it of first importance to be careful that the employment of Artillery does not lead to disappointment.

It will be of no use to strive and push for the employment of Artillery—*quand même*—where its presence would be an encumbrance. A blind advocacy of the claim of Artillery to be employed is dangerous; better that it should not take the field at all than that it should be found superfluous, unwieldy, ineffective, and that the tone and professional spirit of its Officers be weakened as they would be in consequence.

What then, let us enquire, are the reasons for rejecting the employment of Artillery as urged by General Gordon? Clearly they are the *impedimenta* it brings, and the ineffectiveness of its fire against a scattered unformidable enemy, and in the absence of defences which Artillery fire can overcome.

What was the nature of the Artillery equipment he had in review? What the country, and what the enemy?

The guns were, we believe, 200 lb. 7-prs. on wheeled carriages drawn by mules, with probably a considerable train of ammunition on wheels, the whole forming in that rough country a cumbrous equipment, while opposed were troops, if they could be so called, of no coherence but of considerable mobility, having at their back rugged fastnesses and kloofs offering, we may believe, absolute protection against shrapnel and comparative immunity of danger from the feeble shell of the 7-pr. gun. There was no enemy surging in masses up to our men's faces as they stood in square.

But it has been learnt that wheeled carriages are not inseparable from a very effective Artillery, and we are probably in the way to make a still greater use of that lesson. Just as pack transport was the rule in this country before the era of the improvement of our roads, so we have found that, whether on plain ground or in mountain country where no roads are we must revert to pack carriage as the remedy; and this is especially true in hot countries where work in draught is more distressing to animals.

Wheeled carriages and an excessive ammunition train are the pest of an Artillery Commander in savage warfare. Whatever may be considered desirable for reserves, the want of coherence and absence of tenacity in a savage enemy must, in our opinion, ever render it unnecessary to have any large supply of ammunition at the front. For every expedition, therefore, against a savage foe, the scales of ammunition we are accustomed to would require revision and reduction.

If wheeled carriage is inadmissible for guns, what can be said of its employment for the sake of the "feeble weapon" the machine gun, which too, with its rapid consumption of ammunition, calls for a not inconsiderable reserve at its back? Indeed, it would seem worth

enquiry whether the *impedimenta* offered by machine guns have not on more than one occasion been laid at the door of guns proper, and tended to discredit the legitimate arm.

In conclusion, we believe Artillery will hold its own in the estimation of commanders and of the troops at large in every description of warfare. The proportion of guns would vary, as it always has done, according to circumstances; but we aim at standing on sound ground, and, by careful adaptation of means and appliances to ends, that our presence should be desired, and in no way allowed on sufferance.

Once assured of the adequacy of those means, and of the moderation of our demands for equipment and carriage, every Commander will not only welcome but claim his fair proportion of Artillery.

Extract from Colonial Blue-book, Cape of Good Hope.

Correspondence between Government and Commandant-General of Colonial Forces, Major-General C. G. Gordon, C.B., R.E., printed at Cape Town, 1883:—

Page 35. "B. Reorganization of Colonial Forces.

"The Honourable
"The Colonial Secretary.

"*King William's Town, 6th June, 1882.*

"Sir,—I have drawn up a memorandum on the Colonial Regular Forces which"

. . . .

"I may be egotistical, but I think the report I now send should be made known. The argus-eyed public will detect the defects; the Ministry are not involved in its good or bad reception; and no harm can be done, as the question is one that affects the whole colony.

"I have, &c.,

(Signed) "C. G. GORDON,
"Major-General, R.E., & Commandant-General."

"Report.

"*Colonial Regular Forces.*

"1. The following salient points of the future reorganization of the above forces are put forward as the forecast of my ideas on the subject. It is for the Ministry of the Colony to decide whether they meet with their approval, or in what way they should be modified."

. . . .

"*Cape Field Artillery.*

"13. The Cape Field Artillery costs £13,512 per annum, and consists of 50 officers 87 men, or £147 per man.

"14. I am afraid I must now digress into somewhat irrelevant and egotistical matter, namely, the value of Field Artillery with moveable columns acting against native forces, or forces which fight a guerilla warfare.

"15. I grant that for the defence of fortified posts Field Artillery is of the greatest use, but in the movement of troops against the skirmishing mode of fighting of guerillas, its effects are very inadequate and out of all proportion to the delay and requirements which its transport along bad roads involves.

"It is always the cause of anxiety to a Commander.

"It is always the point whereon guerillas concentrate their fire.

"The scattered order of the guerillas, their aptness to take advantage of cover, and the smallness of the calibres of the guns render its effects almost nugatory.

"Considering the trouble of its transport, what part did the Field Artillery play in the Ashantee campaign, where the crisis was decided in the bush by the Infantry? What part did it play in the Abyssinian campaign, when, in spite of the Artillery fire, no entrance was found in the fortified refuge which King Theodore and his seven followers defended against the British troops, and which refuge was entered by a man scrambling over its entrenched wall? What part did it play at Lange's Nek, Ugogo, and Majuba? At Ugogo, through the necessity of guarding it, it formed the centre on which the Boers directed their fire; it was their target, and tied the British troops to one spot.

"In the Appendix E. is shown what effect it had on the enemy at Morosi's Mountain and in Basutoland. The amount of transport and length of road the Cape Field Artillery covered is also shown in Appendix D.

"It must be also considered that the breaking down of an Artillery wagon is a casualty to be constantly expected, and that such a casualty in a bad narrow road entails the delay of the whole column in perhaps a most dangerous portion of country. I will even go further, and say that when native guerillas get accustomed to Field Artillery fire and take to stockading themselves in earthworks, Field Artillery fire (unless in quantity far exceeding the general means of transport which are at the disposal of a Commander) will not drive the enemy out of their stockades, *vide* New Zealand wars.

"17. I am therefore altogether against the taking of Field Artillery with moveable aggressive columns. They should be with the reserve, and for the defence of posts, where they are invaluable.

"18. The Cape Field Artillery is now formed, and is as efficient as it can be, and therefore, however expensive it may be, I would not propose to destroy it. My proposition would be to enlarge its sphere of action, to entrust it with the duties of pioneers or sappers, such as the heliograph, the crossing of rivers, and such-like sappers' work, in addition to its own proper duties. I should dismiss the mule establishment and reduce expenses.

"19. I would wish that the Officers of the Cape Field Artillery should be liberal in their relations with the other regular forces.

"20. The ordinary field gun has no mystery about it, and whatever may be the high training which Artillery certainly require in Continental armies, a very comparatively short time is required to teach men of average intellect how to use a field gun.

"21. The Afghans had no special school of gunnery. The Chinese when they sunk the British gunboats at Peiho had none, yet their fire was most effective. Therefore, I would say, let there be a brotherhood between the Cape Field Artillery and the other forces, and let the former aid the latter in every way to use guns.

"22. The paramount fault of the British Army—the fault which brings disaster on us—is the jealousy of the Army departments. The Engineers keep their *métier* a secret from the Infantry, the Ordnance Department keep their *métier* from the

Artillery; and so this jealousy goes on through the Army, and will do so until the British Army gets a steam hammer man like the Duke of Wellington, who will mash up all departments into one homogenous mass, actuated by one spirit, that of the welfare of the whole Army, and not of the self-advancement of any particular department.

"23. My experience of rockets is that they are effective against native tribes; and though it is said that they deteriorate in this country by jolting of wagons, I think it would be worth while to try whether by some other means of transport that defect may not be got over."

. . . .

(Signed) "C. G. GORDON,
"Major-General & Commandant-General."

EXTRACT FROM APPENDIX E.

(*Cape Field Artillery.*)

"It is difficult here to obtain any account of the casualties among the natives during the late war in Basutoland.

"In the Colonial forces at Morosi's Mountain 28 men were killed and 65 wounded; in Basutoland, 77 men were killed and 141 wounded.

"As for the effects of Artillery fire the accounts differ. I have a report from good authority that 5 natives were killed and 5 wounded by Artillery fire at Morosi's Mountain.

"The average length of the column of Artillery was nearly 1000 yards.

"At Morosi's Mountain 1443 rounds of Artillery were fired; in Basutoland, 2395 rounds.

"I cannot help repeating that, except for defence of positions, in these native wars, the trouble and expense of the transport of Artillery is out of all proportion to the effects that are produced; and I therefore strongly recommend that the Cape Field Artillery should be utilized, in addition to their *rôle* of Artillery, by being made pioneers."

BATTLE OF ALBUERA.

During the late re-arrangement of the Regimental Library, Woolwich, a Portfolio was found containing sketches of some of the battles in the Peninsula, with the names and positions of the Batteries engaged. The sketches, made by various officers, were collected by Sir W. Robe, who died in Woolwich in 1820. The sketch given of Albuera is by Lieutenant Unger of the Artillery of the King's German Legion.—*H.W.L.H.*

Description to the Plan of the Battle of La Albuera, Fought by the Allied Forces against the French, on the 16th May, 1811.

When the 4th Division, and the Spanish Corps under Don Carlos D'Espagne, on the said morning at about 9 o'clock, arrived near Albuera, the French (who were advancing on the road leading to St. Marta and Solana) had already attacked the village and bridge of Albuera. A Brigade of Horse Artillery, supported by Cavalry and Light Infantry, was drawn up about 600 yards in front of the bridge, and opened upon the troops defending the bridge and village. The Light 6-Pr. Brigade, German Artillery, of the 2nd Division, was posted on the right of Albuera with few Cavalry; the Light Division, G. L., in the village, having at both bridges some Riflemen a little in front. The 2nd Division of Infantry and General Hamilton's Division were drawn up in Line. On the heights above Albuera the Spanish Corps of General Blake on the right.

As the Brigade 9-Prs. was placed on the commanding spot within 700 yards of the place, and the French marched down a body direct to the village, I presume a grand attack was expected on those Heights; but at the same time their largest force marched to their left on the roads pointed out in the plan; part of their Cavalry crossed the small rivers a little above the bridge, moving up the valley.

Many of our troops were immediately ordered to march to the right; a heavy rain came on, which prevented us for some time to perceive the disposition of the enemy. Our Cavalry and some Spanish troops were still skirmishing with the French advanced guards, till a Brigade of the 2nd Division arrived on the right. Maj.-Gen. Cole, Commanding the 4th Division, deployed on the right of the Spaniards but had their right thrown back. Colonel Colbourne being ahead of the column of the 2nd Division, advanced with the Brigade, and 4 guns G. A., formed across the hill within 90 or 100 yards of the enemy.

The French had already possession of the favourable heights opposite, where they had placed 2 Brigades of Artillery: they likewise advanced with their Columns, with Cavalry on their flanks.

The right Brigade of the 2nd Division charged them immediately with the bayonet; when, that very instant, a Polish Regiment of Cavalry (Pikemen) wheeled round, fell in rear of Brigade, sabred down many of the Infantry and Artillerymen, took 1 howitzer, 2 guns, and near 700 prisoners; the remainder of the Brigade were lying dead and wounded on the spot.

The centre Brigade of the 2nd Division then came up with 2 guns, put a stop to the rapid advance of the French, who charged at the same time with a Regiment of Cavalry. Brig.-Gen. Harvey's Brigade of Portuguese Infantry then went off after receiving a volley.

Then the left Brigade of the 2nd Division, who was then in Line, supported by 4 9-Prs., R.A., and the 4th Division with a Light 6-Pr. Brigade on the right, and the whole of British Cavalry, with 4 guns, R.H.A., on the flank, advanced in line, charged the enemy at different times with the bayonet (particularly the left Brigade of the 2nd Division and Fusileers of the 4th), drove them from all the ground they had gained, recovered 2 of the guns the enemy had taken, and threw the enemy's lines in disorder and flight.

The French Cavalry, much superior to ours in number, retired in good order, covering the retreat of the Infantry from being cut up by our Cavalry.

The enemy made a stand on the right bank of the river, which was fordable, but was soon dislodged by our Light Infantry and Artillery. They left a rear guard of about 4000 or 5000 Infantry, with a Brigade of Artillery and Cavalry on the hill between the two rivers, and retired into the wood.

6000 dead were lying on the field of battle. Our loss in killed is estimated to amount to 5000, and that of the French 9000 or 10,000.

A new position then was taken by Marshal Sir Wm. Car Beresford, marked with light colours on the plan.

On the 17th the enemy moved off their wounded, baggage, stores, &c., and on the 18th, in the morning, the rear guard, consisting of almost all their Cavalry, followed on the road leading to Solana, pursued by our Cavalry and Light Infantry.

WILLIAM UNGER, Lieut., G. A.

AZANCHAL,
May 24th, 1811.

PRÉCIS
AND
TRANSLATIONS.

ITALY.

I.

GIORNALE DI ARTIGLIERIA E GENIO,

OCTOBER, 1883.

CAPTAIN E. B. EVANS, R.A.

A FUZE WITH TWO-FOLD ACTION, AND A UNIVERSAL PROJECTILE FOR FIELD ARTILLERY.

BY CAPTAIN U. ALLASON, ITALIAN ARTILLERY.

(Continued from No. 12, Vol. XII).

ALTHOUGH the problem of discovering a projectile which can be employed for all Field Artillery purposes has not yet been solved, there is no longer any doubt among Artillerists that the only projectile capable of such employment is the shrapnel shell. Almost all the writers of recent times, who have dealt with the mode of action of Field Artillery shells, agree in saying that in firing against troops the effects of shrapnel are distinctly greater than those of common shell, especially if we take into consideration the natural cover which may be met with on the field of battle, and of which there is an increasing tendency to make use. Almost all are also agreed in affirming that the greatest effect can be obtained by the use of shrapnel shell provided with a double-action fuze, so as to be capable of being burst either by time or by percussion action, as circumstances may require.

We need not refer here to the numerous considerations, which, in studying the question of a universal projectile for Field Artillery, militate in favour of the shrapnel, but may consider its suitability as fully established. The problem has now become that of determining, not the species of shell, but the type of shrapnel best suited to the purpose.

At the time, however, when this question was first raised in Italy, the superiority of the shrapnel over the common shell, for all purposes, had not been fully established, so that it did not, at that time, appear superfluous to pursue a course of experiments, with a view to proceeding to make the selection of a projectile with all the caution required by the importance of the matter, and to establishing, besides the relative

efficacy of the two projectiles, also the possibility of replacing, by shrapnel, both the common shell hitherto employed for rounds fired to determine the range, and the case shot used for defence at close quarters against sudden attacks by Infantry or Cavalry.

Given the possibility of providing a good double-action fuze, the problem had to be studied with reference to the following conditions :—

The comparative efficacy of shrapnel and common shell, fired against troops, exploded by percussion or by time-action, at long and at short ranges.

The possibility of employing the shrapnel for determining the range, or the relative difficulty of judging the position of the explosion of common and of shrapnel shell, when exploded by percussion.

The comparative efficacy of shrapnel and case shot, when the shrapnel is burst a short distance from the muzzle.

In a secondary degree it was of interest to ascertain what effects could be produced by shrapnel, in the nature of demolition, against the houses and walls to be met with in the field, in order to determine whether the equipment of a Field Battery should include only the one species of projectile, or whether the change should be limited to merely increasing the proportion of shrapnel and still retaining a certain number of common shell, to be used only for the demolition of obstacles on which the shrapnel were unable to produce sufficient effect.

These researches were undertaken as soon as the experiments in connection with the double-action fuze gave such results as promised a satisfactory solution of that question. About that time it had also been recognised that the shrapnel was superior to the common shell, for use against troops, when both were fired with time fuzes.

The experiments by which this superiority was determined have been already described; and they were made not only with a view to studying the comparative efficacy of the two projectiles, but also with that of determining the most convenient type of shrapnel for our field guns of larger calibre; to be introduced, either in case the obtaining of a good double-action fuze should allow the adoption of a universal projectile to be taken into consideration, or simply in order to substitute a more effective nature of shrapnel for the one with central bursting charge hitherto in use.

These experiments led to the construction of the diaphragm shrapnel for the 9cm B. L. gun, distinguished by the denomination *pattern No. 3, modified*, in favour of which it seems to have been shown: that the effects of the explosion were notably more powerful than those produced by the shrapnel with central bursting charge, but that they acted much less in a lateral direction; that in order to obtain the proper dispersion of the bullets it was necessary to give a greater interval between the point of explosion and the object fired at; and that in consequence a doubt arose whether this necessity for giving a greater interval, might not increase the difficulty of observing the effects of the fire, owing to the greater height at which the shell must necessarily burst.

To decide this question, upon which seemed to depend the entire suitability of the diaphragm shrapnel, special trials were ordered to be

made by certain regiments, with a view to obtaining evidence to show to what extent, under ordinary circumstances, the necessity for making the shells burst at a considerably greater height than with the shrapnel with central charge, rendered the accuracy of firing more difficult.

These experiments were carried out during the gunnery course of 1879 by five Regiments of Field Artillery, to which were issued a certain number of diaphragm shrapnel shells for the 9^{cm} B. L. gun; these regiments were instructed as to the general principles of their use, and they were also recommended to try firing some rounds with a gradually diminishing elevation, so as to lower the point of explosion, and to ascertain what portion of the target was struck in each case; and, finally, the general direction of the observations to be made was summed up in the following queries:—

Whether the fact that with shrapnel having the charge at the base, it was necessary to allow a greater interval between the point of explosion and the object aimed at, and therefore to produce the explosion at a greater height, rendered the proper laying of the gun more difficult in practice than with the shrapnel with central charge?

Whether the possibility of obtaining as good effects with small intervals as with very considerable ones, would not in practice render it easier to produce good results with shrapnel?

The opinion pronounced by the Officers of these regiments was in the highest degree favourable to the diaphragm shrapnel; but it was also remarked that the experiments were on too limited a scale to allow an absolute and definite value to be assigned to this judgment.

It was not found possible to carry out all these trials so as to compare the action of the two natures of shrapnel under similar conditions, and it can be easily understood that an exact comparison could only be drawn from experiments made under precisely similar circumstances of time and place; seeing that the state of the atmosphere, and the nature of the locality, have a great influence upon the judging of the position of the point of explosion, and upon the consequent possibility of correcting the aim; besides which, the particular condition of the ground upon which the targets are placed exercises a considerable influence upon the *ricochet* of the bullets, and thus upon the number of hits.

The great majority of the Officers charged with carrying out these experiments among the regiments, agreed in stating that, in these trials, they had not found more difficulty with the diaphragm shrapnel than with the ordinary, in judging the effect of a round and thus correcting the aim, &c.; and it was recognised as of the greatest importance in practice, that the shrapnel with the charge at the base offered the advantage of producing a considerable effect, even with very large intervals between the explosion and the object, so as thus to compensate for the errors that might be made in judging the distance, and the irregularities which were frequently found in the time of burning of the fuzes.

The necessity for leaving no doubt upon these points, led to a further series of trials in firing at unknown ranges, comparing the effects of

the diaphragm shrapnel with those of the shrapnel with central charge; these experiments were made, as far as possible, under the conditions of actual warfare; that is to say, by carrying them out in places with which the officers in charge of the firing were not acquainted, and determining the range by means of common shell.

The first trial was made against three lines of targets 30 mètres long, placed at 20 mètres interval one behind the other, and divided so as to represent Infantry in line. A second trial was made against targets representing Infantry in extended order, kneeling, and standing. In both cases the diaphragm shrapnel were fired with fuzes, the graduation of which, based upon the results of former experiments, should have given intervals decreasing from 150 mètres at the shorter range, to 90 mètres at the longer; and the shrapnel with central charge, with the ordinary fuzes for that nature of projectile, graduated so as to give intervals of from 65 to 35 mètres.

The results of the first trial are given in Table A; in which it should be noted that the person who carried out the practice was not aware that the range was, in each case, the same for the two projectiles, so that for each series of rounds the range was determined by firing common shell, and the differences between the ranges thus found must be attributed to the unavoidable differences in the firing of different guns, and to differences in the ammunition, &c.

TABLE A.

Shrapnel Shell.	Number of Rounds.	Range in mètres.		Position of Point of Explosion.		Number of Hits.							
						1st Line.		2nd Line.		3rd Line.		The 3 Lines.	
		Actual.	Estimated.	Average Interval in mètres.	Average Height above Plane in mètres.	Total.	Average per Effective Round.	Total.	Average per Effective Round.	Total.	Average per Effective Round.	Total.	Average per Effective Round.
With central charge	25	1245	1150	97	3·9	499	23·7	480	20·9	294	12·8	1273	57·4
Diaphragm	25	1245	1100	122	5·3	799	36·3	786	34·1	622	25·9	2207	96·3
With central charge	30	1679	1550	138	4·8	437	14·6	292	9·7	194	6·5	923	30·8
Diaphragm	30	1679	1700	82	4·5	1194	45·9	785	29·1	572	21·2	2552	94·0

The officer conducting the practice, however, modified, in the course of it, the elevation and the graduation of the fuze, in accordance with the judgment made from the Battery of the position of the points of explosion. In comparing, with reference to the two varieties of shell, the figures representing the actual range, that determined by trial, and the average interval between the point of explosion and the target, it may be seen that the firing with the diaphragm shrapnel was much more accurately regulated than that with the shrapnel with central charge. It must not, however, be supposed that the observation of the

points of explosion was found, contrary to expectation, to be easier with the former than with the latter projectile. On the contrary, during the practice it was noticed that the difficulty of observation was the same with both, which is only natural, when we consider that there was but little difference in the altitudes at which the different shells burst. It would seem rather, in this case, that the fact that the firing with diaphragm shrapnel was the better regulated of the two, must be attributed to other causes; but seeing that the shrapnel with central charges were actually exploded at too great intervals for that nature of projectile, it is necessary to take that fact into consideration when looking at the very great superiority of the diaphragm shrapnel as shown by the number of hits. It being recognised, in consequence, that the results of this trial could not be considered altogether conclusive, the second series was proceeded with, the results of which are shown in Table B.

TABLE B.

Shrapnel Shell.	Number of Rounds.	Range in mètres.		Position of Point of Explosion.		Number of Hits.							
						1st Line.		2nd Line.		3rd Line.		The 3 Lines.	
		Actual.	Estimated.	Average Interval in mètres.	Average Height above Plane in mètres.	Total.	Average per Effective Round.	Total.	Average per Effective Round.	Total.	Average per Effective Round.	Total.	Average per Effective Round.
With central charge [1]	25	1475	1350	144	2·9	77	3·3	67	2·9	89	3·9	233	10·1
Diaphragm [1]	25	1475	1350	201	5·8	157	6·8	129	5·6	118	5·3	404	17·1
With central charge [2]	30	2620	2550	68	6·4	66	3·3	81	3·2	92	3·7	239	9·9
Diaphragm [2]	30	2620	2550	96	6·7	178	6·1	82	2·8	43	1·5	303	10·1

[1] The 1st line of targets represented 25 men kneeling at file interval: the 2nd line was placed 75 mètres behind the 1st; the 3rd at 75 mètres behind the 2nd, and on each side were added targets 15 mètres in length.

[2] The targets were placed as above, but represented men standing, and were arranged in a position almost concealed from view.

In this trial the officer conducting the practice knew that the ranges were the same in each case for the two natures of shrapnel; so that when once it had been determined by means of common shell, the firing with shrapnel was proceeded with, regulating it for each species of projectile by the position of the points of explosion, as judged from the Battery.

The result obtained is specially worthy of note in the case of the first range, on account of the circumstance that an error of 100 mètres having been made in the determination of the range, and the fuzes having been graduated for the range as determined, and acting with great regularity, the intervals were in reality greater by 100 mètres

than those usually given for each projectile at such a range; and that the number of hits produced by the diaphragm shrapnel was more than double on the first line of targets, and but little less than double on the whole of the three lines together, compared with the hits obtained from the shrapnel with central charges.

With regard to the number of files struck, or to the lateral dispersion of the fragments, these experiments showed clearly one fact: namely, that, although it is certainly the case that with equal intervals a single diaphragm shrapnel covers a considerably smaller front than is covered by a shrapnel with central charge, this difference soon disappears when several rounds are fired; and from the natural dispersion, in a lateral sense, of the points of explosion, after five or six rounds, even fired from the same piece and with practically the same laying, no sensible difference would be recognised between the two natures of projectiles in this respect. Besides, it would be a mistake to give too much importance to the lateral dispersion of the hits, or at least to assign more importance to it than to the superior number of hits, when this latter superiority is so great as that given by the diaphragm shrapnel in comparison with the shrapnel with central charge; and to lose sight of the other very great advantage of the diaphragm shrapnel, namely, that of being able to produce considerable effects with intervals between the point of explosion and the object, such as would destroy all the effect of the shrapnel with central charge.

It should be noted that from the experiments made by us, it appears that the proportion between the frontages covered by the fragments of the two projectiles is about as 1 to 2·5,[1] considering only the effect of one round; but this proportion is only maintained when the intervals are equal, and the difference diminishes more rapidly than the difference between the number of hits diminishes as the interval for the diaphragm shrapnel is increased; so that it may be said that when the frontages covered become equal, the latter projectile still produces an effect sensibly superior to that of the shrapnel with central charge.

Another circumstance takes away all value from the question of the dispersion, and that is, that in actual warfare the firing would never be from one gun alone, but from a certain number of guns in a Battery, between which, naturally, the object to be fired at would be divided when it presented a certain amount of lateral extension. This eliminates altogether the disadvantage of a too great concentration of effect; and it is even an open question whether such concentration

---

[1] The angle of the cone of dispersion of the bullets is about 10° with the diaphragm shrapnel, and about 23° with that with central charge, and the frontages covered vary as the tangents of these angles. The above are the angles given at the ordinary ranges fired at on service; the angles of the cone of dispersion of the diaphragm shrapnel of 9cm, derived from actual experiments, are the following:—

At 800	mètres	... ...	8° 24′
1200	"	... ...	9° 00′
1600	"	... ...	9° 42′
2000	"	... ...	10° 42′
2400	"	... ...	11° 48′
2800	"	... ...	13° 00′

is a disadvantage at all or not, since it may reasonably be asked whether it is not better, in most cases, to produce a powerful impression at a particular point, than to spread the result over a greater space, with a loss of moral effect.[1]

From the whole of the trials carried out with the shrapnel shells for 9^{cm} B. L. guns, and from the observations made in the course of the same, it seems possible to make the following comparison between the two natures of shrapnel:—

There is no very great difference between the two projectiles, in regard to the difficulty of judging the position of the point of explosion, and of correcting the elevation, &c.

With equal intervals between the points of explosion and the object, the diaphragm shrapnel, round for round, gives a considerably greater number of hits, and a considerably smaller lateral dispersion; but the difference in the dispersion diminishes rapidly as the number of rounds is increased.

With an equal lateral dispersion, the diaphragm shrapnel gives a rather larger number of hits.

With large intervals between the points of explosion and the object, the diaphragm shrapnel produces effects very decidedly greater than those of the shrapnel with central charge; and the former also produces appreciable effect with intervals with which the latter would produce no effect whatever.

Such being the case, there could be no doubt as to which of the two projectiles to choose for the continuation of the experiments, to be made with a view to the adoption of a single projectile for all purposes. Considering that, in the firing of Field Artillery on Service, the range is always the unknown quantity, and that the effects of inaccuracy in the determination of this are frequently increased by irregularity in the action of the fuze or by the graduation of the latter not always corresponding with the elevation; considering that either from some defect in the gun, or in the powder, or from atmospheric influence, or from all these causes combined, it often happens that the range, as determined by firing, differs somewhat from the actual range; and considering, finally, that the range however accurately determined, may very soon be altered by the moving of the object fired at, it was only natural that great importance should be assigned to the advantage

---

[1] The following remarks, taken from a short but interesting paper on the effects of shrapnel shell, published in the *Revue d'Artillerie*, seem suitable for quotation in connection with this point:—"We shall only say a few words on the subject of dispersion. At short ranges a wide dispersion is useful; but it is a mistake to consider it useful in all cases. It is quite evident that there is no object in concentrating a discharge of grape shot upon a single point; but it is not equally certain that it would be advisable always to give to such a discharge as wide a dispersion as possible. With an equal number of men disabled, the moral effect is far greater when the men struck are close together. A single round from a gun which kills six men, shakes the line far more than a volley of musketry which might produce the same result in a certain extent of front. Too much attention also has been paid to attempting to produce a dispersion which would give only one ball per file . . . . . . To make sure of hitting it is not too much to allow four or five balls per man. The greater probability of striking will compensate for the diminution of front covered."—*Revue d'Artillerie: August, 1882.*

than those usually given for each projectile at such a range; and that the number of hits produced by the diaphragm shrapnel was more than double on the first line of targets, and but little less than double on the whole of the three lines together, compared with the hits obtained from the shrapnel with central charges.

With regard to the number of files struck, or to the lateral dispersion of the fragments, these experiments showed clearly one fact: namely, that, although it is certainly the case that with equal intervals a single diaphragm shrapnel covers a considerably smaller front than is covered by a shrapnel with central charge, this difference soon disappears when several rounds are fired; and from the natural dispersion, in a lateral sense, of the points of explosion, after five or six rounds, even fired from the same piece and with practically the same laying, no sensible difference would be recognised between the two natures of projectiles in this respect. Besides, it would be a mistake to give too much importance to the lateral dispersion of the hits, or at least to assign more importance to it than to the superior number of hits, when this latter superiority is so great as that given by the diaphragm shrapnel in comparison with the shrapnel with central charge; and to lose sight of the other very great advantage of the diaphragm shrapnel, namely, that of being able to produce considerable effects with intervals between the point of explosion and the object, such as would destroy all the effect of the shrapnel with central charge.

It should be noted that from the experiments made by us, it appears that the proportion between the frontages covered by the fragments of the two projectiles is about as 1 to 2·5,[1] considering only the effect of one round; but this proportion is only maintained when the intervals are equal, and the difference diminishes more rapidly than the difference between the number of hits diminishes as the interval for the diaphragm shrapnel is increased; so that it may be said that when the frontages covered become equal, the latter projectile still produces an effect sensibly superior to that of the shrapnel with central charge.

Another circumstance takes away all value from the question of the dispersion, and that is, that in actual warfare the firing would never be from one gun alone, but from a certain number of guns in a Battery, between which, naturally, the object to be fired at would be divided when it presented a certain amount of lateral extension. This eliminates altogether the disadvantage of a too great concentration of effect; and it is even an open question whether such concentration

---

[1] The angle of the cone of dispersion of the bullets is about 10° with the diaphragm shrapnel, and about 23° with that with central charge, and the frontages covered vary as the tangents of these angles. The above are the angles given at the ordinary ranges fired at on service; the angles of the cone of dispersion of the diaphragm shrapnel of 9^{cm}, derived from actual experiments, are the following:—

At	800 mètres	8° 24′
	1200 "	8° 00′
	1600 "	9° 42′
	2000 "	10° 42′
	2400 "	11° 48′
	2800 "	13° 00′

is a disadvantage at all or not, since it may reasonably be asked whether it is not better, in most cases, to produce a powerful impression at a particular point, than to spread the result over a greater space, with a loss of moral effect.[1]

From the whole of the trials carried out with the shrapnel shells for 9^{cm} B. L. guns, and from the observations made in the course of the same, it seems possible to make the following comparison between the two natures of shrapnel:—

There is no very great difference between the two projectiles, in regard to the difficulty of judging the position of the point of explosion, and of correcting the elevation, &c.

With equal intervals between the points of explosion and the object, the diaphragm shrapnel, round for round, gives a considerably greater number of hits, and a considerably smaller lateral dispersion; but the difference in the dispersion diminishes rapidly as the number of rounds is increased.

With an equal lateral dispersion, the diaphragm shrapnel gives a rather larger number of hits.

With large intervals between the points of explosion and the object, the diaphragm shrapnel produces effects very decidedly greater than those of the shrapnel with central charge; and the former also produces appreciable effect with intervals with which the latter would produce no effect whatever.

Such being the case, there could be no doubt as to which of the two projectiles to choose for the continuation of the experiments, to be made with a view to the adoption of a single projectile for all purposes. Considering that, in the firing of Field Artillery on Service, the range is always the unknown quantity, and that the effects of inaccuracy in the determination of this are frequently increased by irregularity in the action of the fuze or by the graduation of the latter not always corresponding with the elevation; considering that either from some defect in the gun, or in the powder, or from atmospheric influence, or from all these causes combined, it often happens that the range, as determined by firing, differs somewhat from the actual range; and considering, finally, that the range however accurately determined, may very soon be altered by the moving of the object fired at, it was only natural that great importance should be assigned to the advantage

---

[1] The following remarks, taken from a short but interesting paper on the effects of shrapnel shell, published in the *Revue d'Artillerie*, seem suitable for quotation in connection with this point:—"We shall only say a few words on the subject of dispersion. At short ranges a wide dispersion is useful; but it is a mistake to consider it useful in all cases. It is quite evident that there is no object in concentrating a discharge of grape shot upon a single point; but it is not equally certain that it would be advisable always to give to such a discharge as wide a dispersion as possible. With an equal number of men disabled, the moral effect is far greater when the men struck are close together. A single round from a gun which kills six men, shakes the line far more than a volley of musketry which might produce the same result in a certain extent of front. Too much attention also has been paid to attempting to produce a dispersion which would give only one ball per file . . . . . . To make sure of hitting it is not too much to allow four or five balls per man. The greater probability of striking will compensate for the diminution of front covered."—*Revue d'Artillerie: August, 1882.*

possessed by the diaphragm shrapnel of being capable of producing a good effect with such very different intervals between the point of explosion and the object, an advantage which might counteract in part, if not entirely, the effects of errors made in the range, &c.

In looking also at the question of the adoption of a universal projectile, there is another point in favor of the diaphragm shrapnel which must not be overlooked; namely, that it contains a bursting charge of more than four times the amount of that of the service shrapnel, which should greatly facilitate the observation of the point of explosion in cases where the projectile bursts by percussion on touching the ground.

The experiments relating to the question of the universal projectile for the heavier Batteries were therefore continued with the diaphragm shrapnel, and at the same time similar experiments were undertaken with 7^{cm} shrapnel for the light Batteries.

Before occupying ourselves with these latter, let us complete what we have to say on the subject of the guns of larger calibre.

The first point which it was desired to determine experimentally, was that with regard to the possibility of employing shrapnel in place of the common shell hitherto used for ascertaining the range. With this view, practice was carried out with common shell and with shrapnel, furnished with double-action fuzes arranged to act by percussion, and the result was noted from the Battery, and at the same time by a range party, so that the result as judged might be compared with that which was actually the case.

These experiments were carried out by taking first a target representing the front of a half company of Infantry standing at 1500, and afterwards at 3000 mètres; after this a target representing a single platoon (quarter company ?) kneeling was placed at 3000 mètres, and finally the practice was repeated at 1500 mètres at a simple mark.

The result of these experiments, which were made with a sufficiently large number of rounds, and under various atmospheric conditions, may be taken to be the more conclusive, inasmuch as they were repeated also in part with the shrapnel with central charge, with which it was supposed that the judging of the position of the point of explosion from the Battery would be still more difficult, on account of the smaller amount of smoke produced by its explosion, its bursting charge being considerably smaller than that of the diaphragm shrapnel.

The result showed that, under similar conditions of nature of the locality, target, and atmosphere, there is no appreciable difference in the facility of making accurate observations on the common shell and the shrapnel, either that with the charge at the base, or that with central charge, and showed :—that the judging of the position of the point of explosion was equally easy with the two natures of projectile in the case of the first targets mentioned above, which presented a plainly visible area, against which the smoke produced by the explosion was easily seen; that it was equally difficult in the case of the second target, at the long range of 3000 mètres; and that it was most difficult with both projectiles, when, as in the third case, the target consisted of

a simple isolated point, and the effect could not be observed from an elevated position commanding the ground where the shells struck.

The natural conclusion to be drawn from these experiments was, that the substitution of shrapnel for common shell, for use in ascertaining the range, would in no way render that operation either easier or more difficult; this depending far more upon the nature of the ground, the state of the atmosphere, and the kind of object fired at, than upon the nature of the shell employed.

As an example, we give in Table C the result of one of the numerous series of trials carried out.

TABLE C.

Range in mètres.	No. of Round.	Common Shell.		Shrapnel Shell.		Nature of Target.
		Result as judged from the Battery.	Actual result as measured.	Result as judged from the Battery.	Actual result as measured.	
1500	1	Burst short	Burst short 23 m.	Blind, short	Blind, short 59 m.	A vertical plane representing the front of a half company, standing.
	2	" "	" " 22·5 "	" "	Burst after ricochet; short 63 m.	
	3	" "	" " 22 "	" "	Burst in the ground; short 18·6 m.	
	4	" "	" " 22·5 "	Burst short	Burst short 11 m.	
	5	" "	" " 19 "	" "	" " 21·3 "	
	6	" "	" " 41 "	" "	" " 14 "	
	7	" "	" " 24 "	Could not be seen	" long 0·5 "	
	8	" "	" " 19 "	Struck target	" " 5·3 "	
	9	" "	" " 22 "	Blind, short	Blind, short 21 "	
	10	" "	" " 16 "	Burst short	Burst short 7 "	
3000	1	Burst short	Burst short 65 m.	Burst short	Burst short 110 m.	The same as the above.
	2	" "	" " 6 "	" long	" long 40 "	
	3	" "	" " 22 "	" at range	" " 6 "	
	4	Blind, over	" long 10 "	" short	" short 23 "	
	5	Burst short	" short 9 "	Blind, short	Blind, short 20 "	
	6	" "	" " 4 "	Burst short	Burst " 33 "	
	7	" "	" " 76 "	Blind, short	Blind, " 63 "	
	8	" "	" " 45 "	Burst long	Burst long 20 "	
	9	" long	" long 22 "	Blind, short	" short 7 "	
	10	" at range	... ...	Burst long	... ...	
3000	1	Burst long	Burst long 200 m.	Doubtful	Blind	A vertical plane representing the front of a platoon, kneeling.
	2	" short	" " 50 "	Burst short	Burst short 30 m.	
	3	" "	" " 50 "	" prematurely	... ...	
	4	" long	" " 30 "	Burst short	Burst short 15 m.	
	5	" "	" " 30 "	" "	" " 30 "	
	6	" "	" " 15 "	" "	" " 50 "	
	7	" "	" " 15 "	" "	" " 40 "	
	8	" "	" " 10 "	" "	" " 40 "	
1500	1	Doubtful	Burst long 30 m.	Burst short	Burst short 10 m.	A simple mark.
	2	Burst long	" " 40 "	" "	" " 10 "	
	3	Doubtful	" short 3 "	Doubtful	" " 2 "	
	4	"	" long 5 "	Burst long	" long 7 "	
	5	"	" " 20 "	Doubtful	" short 1 "	
	6	Burst long	" " 6 "	Burst long	" long 20 "	

The comparative efficacy of the common shell and the shrapnel in firing against troops, already decided in the case in which both projectiles were employed with time fuzes, was then studied with the same projectiles exploded by percussion.

With this view repeated trials were made at the ordinary ranges of actual warfare, and at long ranges; and it was ascertained that in this nature of practice also, the shrapnel had a decided superiority over the common shell, not only because it gave a greater number of hits, but also because it produced a certain amount of effect even at ranges at which the common shell became almost entirely ineffective.

It was also distinctly shown that at all ranges the effect of the explosion depends entirely upon the nature of the ground at the spot where the shell strikes, according as it is favorable to *ricochet* or otherwise, and upon the distance between this point and the object fired at; and with regard to the latter it is to be noted that, whilst with the common shell the effect diminishes rapidly with the increase of this interval, the shrapnel, on account of the more regular form of the fragments into which it is divided on explosion, retains a considerable amount of power, even when the shell bursts at such a distance that with common shell all the effect would be lost.

In order to obtain a sufficient number of explosions under similar conditions, it was necessary to increase to some extent the number of rounds, especially at the longer ranges. Table D sums up some of the results obtained in firing at the usual three lines of targets.

TABLE D.

Shell.	Range in mètres.	Average Interval between the Point of Explosion and the 1st Line of Targets.	Average number of Hits per Round.			
			1st Line.		The 3 Lines.	
			Through Target.	Total.	Through Target.	Total.
Shrapnel	1500	15·00 m.	95	101	105	146
Common	1500	23·00 "	35	40	49	68
Shrapnel	3000	38·5 "	1·5	3·3	8	17
Common	3000	27·0 "	0·4	1·0	4·8	9·9
Shrapnel	3000	28·0 "	...	19	...	24
Common	3000	34·4 "	...	12	...	16

From the above experiments it appeared that, on the whole, the useful effect of the shrapnel as compared with that of the common shell is about in the proportion of 2 to 1.

Grouping together the rounds in the various series which could be compared closely, having burst with almost similar intervals, and on

ground of like nature, almost the same conclusion is arrived at, seeing that in this case, the result is represented by the following figures:—

At ordinary ranges:—

For the common shell—Average interval (between the point of explosion and the target), 21 mètres. Average number of hits per round, 43.

For the shrapnel—Average interval, 18 mètres. Average number of hits per round, 81.

The experiments carried out demonstrate, therefore, that also when exploded by percussion, the shrapnel fired against animate objects shows a decided superiority, not much less than that which it exhibits when the two natures of shell are employed in the manner hitherto usually adopted, that is to say, the shrapnel with time fuze and the common shell with percussion. And since experiments previously made had shown that when the two projectiles were both employed with time fuzes, the common shell never produced half the effect given by the shrapnel, it may be safely concluded that for Field Artillery, the fire of which is usually directed against men and horses, the most effective projectile for all purposes is the shrapnel.

The superiority of the shrapnel over the common shell becomes the more evident when we consider the tendency shown in the present day by all troops to take advantage of the cover afforded by all the natural obstacles to be found on the field of battle, and to throw up artificial cover when natural cover is wanting. Comparative trials with shrapnel and common shell were not, indeed, made by us from this point of view; but this was considered by no means necessary, it being sufficiently evident that the bullets released by the shrapnel are better able to search the ground covered by natural or artificial obstacles, than are the splinters of the common shell.

In this respect, therefore, it would have been of more interest to study the comparative effects of the two natures of shrapnel, that with the charge at the base and that with the central charge, in order to determine, by careful experiments, which of the two would prove, in practice, the more effective against troops under cover.

But here again it seems evident that the problem could not be better solved by experiment than by simple reasoning. Given the angles of the cones of dispersion of the two projectiles, it seems evident that, in dealing with objects behind cover, the shrapnel with central charge should be preferable to the diaphragm shrapnel, and there are not wanting experiments made by the Artilleries of other nations which confirm this. But should the superiority which the former projectile shows in this instance, cause us to overlook that which the latter possesses in the case of troops in the open? The reply to this question will be in the affirmative, or in the negative, according as we admit that firing at objects under cover is the rule, and at objects in the open the exception, or *vice versâ*; and, with reference to this point many arguments may be brought forward, the value of which will depend to a great extent upon the personal authority of the person employing them. Amongst ourselves the opinion prevails that the advantages

offered by the diaphragm shrapnel in firing against troops in open country, are of much greater importance than the advantage of placing a few more hits in an object sheltered behind an obstacle; and, in spite of the theoretical inferiority of the diaphragm shrapnel for use against troops behind cover, we continue to give it the preference.

The efficacy of the shrapnel at short ranges, compared with that of case shot, and the possibility of substituting the former for the latter, was studied by means of experiments directed to ascertaining not only the number of points, but also the number of files, that the two natures of projectiles are capable of striking on two lines of targets 60 mètres long, distant 30 mètres one behind the other, and divided so as to represent Cavalry in line.

The trials were made at ranges of 300 and 400 mètres, on level

TABLE E.

Range.	Projectile.	Interval between Point of Explosion and front line.	Hits and number of Files struck. Total. 1st Line.		2nd Line.		Average per Round.	
m.		m.	Hits.	Files.	Hits.	Files.	1st Line.	2nd Line.
Level Ground. 9cm B.L. Gun.								
400	Shrapnel with time fuze......	150	253	50	321	52	42	41
		100	362	40	341	53	60	57
		50	579	23	409	36	96	68
	Shrapnel with percussion fuze	Six projectiles were fired, none of which burst.						
	Case	...	348	58	242	54	69	48
300	Shrapnel with time fuze	280	227	60	160	53	38	27
		180	267	52	420	52	44	52
	Case	...	400	50	292	56	80	52
Uneven Ground. 9cm B.L. Gun.								
400	Shrapnel with time fuze	150	100	40	94	39	17	16
		100	170	31	141	37	28	23
		50	263	21	263	28	44	44
	Shrapnel with percussion fuze	...	403	17	312	25	67	44
	Case	...	160	38	150	37	32	30
300	Shrapnel with time fuze	280	85	42	79	36	14	13
		180	103	45	221	46	17	21
	Case	...	150	39	130	44	30	26

NOTE.—I am not responsible for the accuracy of the figures given in these tables, which I have copied as I found them, except that in one instance I have inserted a figure which had evidently been omitted. They are apparently incorrect in some particulars.—*E.B.E.*

ground and on broken ground; and the effect of the shrapnel furnished with a double-action fuze was studied, both by bursting the shell by time-action at various distances from the muzzle, and by bursting it by percussion by making it strike the ground at short distances in front of the target.

But, as was foreseen, this latter mode of employment was found to be impossible upon level and smooth ground, since, in this case, the percussion fuze was found not to act, on account of the very small angle at which the projectile strikes the ground. On the other hand, in the case of broken ground, explosion was obtained by percussion in a sufficiently large proportion of the rounds fired. The results obtained are shown in Table E.

From the experiments carried out we are able to draw the following conclusions:—

Shrapnel burst by percussion at short ranges produces a considerable effect, but perhaps corresponds less to the requirements of defence at close quarters, because it produces an effect over too small an extent of front.

It is not generally possible to make use of shrapnel burst by percussion for defence against the sudden attacks of Cavalry, because the effect depends entirely upon the nature of the ground, which latter it is almost impossible properly to judge at the moment, and which, in the majority of cases will not be favorable to the action of the percussion fuze. And besides, this nature of fire seems also to be unsuitable, because it requires a certain amount of care in laying the guns, which it would be difficult to observe under such critical circumstances.

Shrapnel employed with a time fuze gives a considerable number of hits and a convenient amount of lateral dispersion when a considerable interval is given between the point of explosion and the object, and the number of hits, as at ordinary ranges, varies in inverse ratio with the lateral dispersion.

Exploded by time-action with a suitable interval, the shrapnel can produce as good an effect as case, whether the result be reckoned in accordance with the number of hits, or the number of files covered. It may also be admitted, judging from the experiments made, that the superiority of the shrapnel increases with the range; while on the other hand the case produces the better effect when the ground is broken and uneven, and this probably on account of the greater weight of the bullet contained in the latter which render *ricochets* more effective.

The use of shrapnel therefore against a sudden attack at close quarters, will always have this defect as compared with the employment of case shot, namely that it requires a certain amount of preparation in order to obtain explosion at intervals which satisfy the necessary conditions, and thus necessitates a loss of time which, however small, may be of the greatest value, and it also requires an amount of steadiness on the part of the men which cannot be expected on these occasions, and which is not required in firing case shot, which is a simpler projectile requiring neither preparation nor accuracy in laying.

It may therefore be concluded that by means of the double-action fuze, described in the first portion of this paper, it is possible to burst shrapnel at short distances from the muzzle, and thus to employ this projectile in a similar manner to case shot, when the supply of the latter may be exhausted, but that it will always be advisable to retain a certain proportion of these latter in the equipment, and this especially on account of the simplicity of their use. I am glad to say, however, that with the new iron carriages, &c., for the 9^{cm} B. L. gun, it has been found possible to carry the case shot in a position which could not be utilised for the transport of other projectiles, and that thus their presence in the equipment will not reduce the number of the other projectiles, which are all carried in the ammunition boxes.

Finally, the experiments against targets in masonry, by which it was sought to ascertain the destructive effect of shrapnel as compared with that of common shell, demonstrated what was foreseen, namely, that the shrapnel is much less effective than the common shell in this point, because it produces a very inconsiderable explosive effect.

It is certainly the case, that with a rather larger number of rounds it is possible, with the shrapnel, to destroy the cottages and the walls more commonly met with in the field; but it is no less the case that in order to retain the present power of the Artillery for these purposes, it will be necessary to have, at all events, in the equipment of the Batteries of heavier guns, a certain number of common shell, to be employed only in the demolition of those more important houses that might serve as strongholds in the defence of certain positions.

SWEDEN.

I.

ARTILLERI-TIDSKRIFT,

NOS. 2 AND 3 FOR 1884.

BY

MAJOR H. W. L. HIME, R. A.

THE general excellence of the 2 and 3 Numbers of the Swedish Artillery Journal for 1884 shows that the gunners are not slumbering in Scandinavia.

The *Artilleri-Tidskrift* usually consists of three parts, under one cover: first, matter which is practically original; secondly, official reports of practice, &c.; and thirdly, extracts from the General Orders. These three parts are separately paged, and it will be seen that there is a general resemblance between the form of the *Tidskrift* and our own "Proceedings."

The subject of "Indirect Fire for Field Artillery" occupies two pretty long articles, in the shape of a *précis* and criticism of a Russian pamphlet upon that subject by K. Huck. The indirect fire in question is not, of course, hap-hazard practice over a hill at people supposed to be lurking behind it, but systematic practice at an object which, although invisible from the Battery, can be seen from an intermediate station. The various means of getting the correct direction and elevation are well described; and the Swedish critic, who by no means binds himself to all the conclusions of the Russian author, concludes by recommending that the last part of every years annual practice should be devoted to indirect fire.

The second article in the 2nd Number is an account of some Swiss experiments with the Rubins rifle; the third, a not very new or instructive paper on the "Changing Front in Action" of Field Artillery. These are followed by an account of a new system of Tactical instruction for Italian Artillery officers, at periods of the year when the Batteries cannot well be got out, and in situations where Batteries cannot well be brought, on account of the crops. The system is a kind of compound of what we understand by Kriegspiel and outpost duty, and looks very well on paper. I doubt if it be of the smallest practical use. This paper is followed by a description of the Gautier Range Finder, with plates.

The third Number contains, among other things, an extract from the *Militair-Wochenblatt*, recommending Infantry Lieut.-Colonels to be attached to the Artillery and Cavalry, to gain some knowledge they stand sorely in need of (*så stort behof*); and concludes with a large number of interesting paras. from foreign journals.

NOTES:

BY VARIOUS HANDS.

R. A. I. PRIZE ESSAY.

The following is the subject for the Prize Essay of 1885:—

> "How far is the question of massing guns in the field affected by modern improvements?"

The candidates must be Officers of the Regiment on full pay, and Members of the R. A. Institution.

The Essays, *which must not exceed 16 printed pages of the "Proceedings,"* must be forwarded to the Secretary so as to reach him on or before the 1st of April next. The Essays to be strictly anonymous, but each to have a motto, and be accompanied by a sealed envelope with the motto written on the outside, and the name of the candidate inside.

The Essays will be submitted for decision to three Judges, chosen by the Committee.

The name of the successful candidate will be announced at the Annual Meeting, and medallists will be distinguished as such in all lists, &c., issued from the Institution; and in the event of a University man gaining the medal, a report of his success will be made to the University of which he may be a member.

The successful Essay will be printed and circulated to members by the Institution.

The Committee have decided to supply the New Edition of the "Handbook for Field Service" to Members, and N.-C. officers ordering it through their Commanding Officers, at 2s. 6d. per copy. This does not include postage, which is as follows:—Home, 3d.; India, 8d.

The following General Order is published for general information :—

G.O. 142.—Staff College.

The following will be the scope of the examination in Military History and Geography to be held in June, 1885, for admission to the Staff College :—

1. Parts I., II., and V. of the "Operations of War" *Hamley*.
2. Franco-German War of 1870–71 generally.
3. Specially—

   The operations before Le Mans from the 5th to the 18th January, 1871.

   The operations on the Ognon, Upper Doubs, and Lisaine from the 5th to the 28th January, 1871.

It has been found that two columns in the recently issued form, "The Royal Regiment of Artillery, by Seniority of Batteries," are practically useless; and it is proposed to utilise these two columns by converting them into one column, headed "Service in the Field," in which the battles, sieges, &c., in which the different Batteries have taken part, will be named in the same way in which the battles of the Infantry are mentioned in the Army List. This proposal can only be carried out by Officers Commanding Batteries sending to the Secretary a list of the actions in which their Batteries have taken part. It is hoped they will do so at their earliest convenience.

The Secretary again calls the attention of Members and Secretaries of Messes to the necessity of enclosing patterns with all orders for stationery. No notice will be taken of any order unaccompanied by a pattern.

Officers Commanding Batteries are informed that Sergeant-Major W. Robson, Royal Horse Artillery, has just published a useful set of questions and answers on the 9-Pr. of 6 and 8 cwt., which can be supplied by the Institution, price 7d., post free.

Sergeant-Major Robson will shortly publish a second set (in one cover) for the 13 and 16-Pr. guns, at the same price.

Cricket, 1884.

ROYAL ARTILLERY *v.* ALDERSHOT DIVISION.

16th and 17th June.

Aldershot Division.

1st Innings.		*2nd Innings.*	
P. Prinsep, b Allsopp	22	c Rodwell, b Allsopp	21
L. N. D'Aeth, c Buckle, b Allsopp	18	not out	3
W. P. Ward, st Davidson, b Bannatine	40	not out	17
K. Harris, b King	92		
H. E. Hotham, b Bannatine	0		
P. Turner, c Griffiths, b Bannatine	0		
C. R. Gainsbury, c Duthy, b King	52		
T. T. Macan, retired	4		
T. W. Blakeway, c sub., b Allsopp	13		
W. Kirke, c sub., b Allsopp	4		
J. C. Tattersall, not out	0	c and b Allsopp	14
Byes 8, leg byes 2, wide 3	13	Byes 2	2
Total	258	Total	57

Royal Artillery.

1st Innings.		*2nd Innings.*	
Major Beaver, b Harris	4	b Prinsep	10
Lieut. C. D. King, c sub., b Ward	40	c Tattersall, b Ward	0
" F. E. Allsopp, c Prinsep, b Ward	29	b Ward	20
Capt. Bannatine, c Prinsep, b Ward	0	b Prinsep	10
" Griffiths, c Prinsep, b Ward	8	c Ward, b Prinsep	24
" Stephenson, b Prinsep	0	b D'Aeth	16
" Davidson, b Prinsep	17	c Harris, B. Ward	5
Lieut. H. de Robeck, b Ward	3	not out	35
" C. R. Buckle, not out	12	c D'Aeth, b Prinsep	37
" R. M. Rodwell, b Prinsep	5	run out	14
Capt. Duthy, absent	0	c and b Prinsep	6
Byes 3, leg byes 1, wide 1	5	Byes 10, leg byes 1, wide 1	12
Total	123	Total	189

ROYAL ARTILLERY *v.* YORKSHIRE GENTLEMEN.

20th and 21st June.

Yorkshire Gentlemen.

1st Innings.	
C. W. Landon, b Allsopp	0
Claude Leatham, c DuCane, b Hardy	28
Rev. H. M. Sims, c Hornby, b Hardy	32
Rev. C. M. Sharpe, b Boteler	89
Capt. Borrowes, c King, b Allsopp	15
J. A. Pease, c Davidson, b Bannatine	47
G. A. B. Leatham, c Bannatine, b Allsopp	25
C. J. Armitage, st Davidson, b Allsopp	4
Capt. Savile, not out	19
Lord Wenlock, c Stephenson, b Allsopp	0
W. F. Tempest, c De Robeck, b Allsopp	0
Byes 9, leg byes 3, wide 1	13
Total	272

Royal Artillery.

1st Innings.		*2nd Innings.*	
Capt. Stephenson, b Sims	42	b Sims	12
Lieut. J. P. DuCane, st Leatham, b Tempest	11	b Landon	28
" F. E. Allsopp, b Tempest	58	l b w Tempest	1
Capt. Hardy, b Sims	8	b Tempest	13
" Bannatine, c Borrowes, b Tempest	20	c and b Sims	7
Lieut. H. de Robeck, c C. Leatham, b Tempest	0	c Borrowes, b Tempest	3
" C. D. King, c G. Leatham, b Tempest	5	b Landon	20
" C. R. Buckle, not out	5	not out	2
Capt. Davidson, c Lord Wenlock, b Sims	2	c Sharpe, b Tempest	7
" Boteler, c Landon, b Sims	0	c Sims, b Tempest	5
Lieut. E. Phipps-Hornby, absent	0	c Landon, b Tempest	0
Byes 5, leg byes 3, wide 1	9	Leg byes 4, wide 1	5
Total	160	Total	103

ROYAL ARTILLERY v. HOUSEHOLD BRIGADE.

WOOLWICH, 26TH AND 27TH JUNE.

ROYAL ARTILLERY.

1st Innings.		2nd Innings.	
Lieut. C. D. King, c Robinson, b Mildmay	7	c Mildmay, b Black	58
" C. R. Buckle, b Black	0	b and b Kenyon-Slaney	23
" F. E. Allsopp, c Kindersley, b Cumnor	132	b Black	14
Capt. Bannatine, c Kindersley b Robinson	19	b Black	81
Lieut. J. P. DuCane, c Kinloch, b Black	40	c French, b Black	3
Capt. Hardy, b Black	6	c Crabbe, b Black	0
" Davidson, c French, b Cumnor	10		
Lieut. E. Phipps-Hornby, run out	6	not out	20
" M. N. Morris, c Crabbe, b Black	2	c Somers Cocks, b Black	0
" W. H. O'Neill, c Kenyon-Slaney, b Cumnor	1	not out	5
" S. Belfield, not out	0		
Byes 1, leg byes 6, wide 4	11	Byes 9, leg byes 4, wide 6	19
Total	234	Total	223

HOUSEHOLD BRIGADE.

1st Innings.	
C. Kindersley, c sub., b Bannatine	55
A. Cotton, b Allsopp	31
H. Mildmay, l b w, b Allsopp	41
D. Kinloch, run out	16
H. Somer Cocks, b Belfield	40
H. French, c Allsopp, b Belfield	15
Corporal Cumnor, b Belfield	1
Lieut.-Col. Kenyon-Slaney, b King	49
Capt. Crabbe, l b w, b Belfield	5
Private Black, b King	10
Corporal-Major Robinson, not out	12
Byes 24, leg byes 4, wide 5	33
Total	308

ROYAL ARTILLERY v. HARLEQUIN C.C.

WOOLWICH, 9TH AND 10TH JULY.

ROYAL ARTILLERY.

1st Innings.		2nd Innings.	
Capt. Davidson, b Stewart	0	c Prothero, b Collins	5
Lieut. T. L. Coxhead, c Moon, b Stewart	16	b Collins	14
" F. E. Allsopp, c Prothero, b Stewart	8	c Johnson, b Collins	0
Capt. Bannatine, c and b Stewart	12	c Hine-Haycock, b Collins	2
Lieut. C. D. King, c Collins, b Stewart	7	b Shaw	36
Capt. Hardy, c Prothero, b Collins	19	c and b Collins	0
Lieut. H. de Robeck, l b w Collins	13	hurt	0
Capt. Anstruther, c Shaw, b Stewart	0	c Stewart, b Collins	24
Lieut. C. R. Buckle, not out	10	c Collins, b Shaw	1
" L. W. Milles, run out	6	c and b Collins	11
" S. Belfield, b Collins	4	not out	1
Leg byes 1	1		
Total	90	Total	94

HARLEQUINS.

1st Innings.	
J. R. Hine-Haycock, b Coxhead	35
F. F. Johnson, b Milles	36
N. E. W. Stainton, b Coxhead	40
E. D. Shaw, c Allsopp, b King	62
W. E. W. Collins, b Coxhead	0
R. E. Prothero, not out	47
A. L. Stewart, run out	18
A. W. Moon, st Davidson, b Coxhead	34
D. B. Wilson, c Hardy, b Coxhead	15
G. D. Rose, l b w Coxhead	10
M. C. Kemp, absent	0
Byes 10, leg byes 6, wide 1	17
Total	314

WAR SERVICES

OF

CERTAIN OFFICERS OF THE REGIMENT WHICH ARE NOT GIVEN IN KANE'S LIST, AND OF CERTAIN OTHERS WHICH ARE ONLY IMPERFECTLY GIVEN.

COMMUNICATED BY

GENERAL SIR J. H. LEFROY, C.B., K.C.M.G., F.R.S., R.A.

No. 1.

AN

ACCOUNT OF THE BATTELS, SEIGES, &c.,

WHEREIN

LIEUT.-GENERAL ALBERT BORGARD

HATH SERVED.

(From a MS. in Royal Artillery Library, Woolwich.)

WITH REMARKS

BY

MAJOR H. W. L. HIME, R.A.,

Secretary, R. A. Institution.

IN THE KING OF DENMARK'S SERVICE.

SERVED as a Cadet in the Queen's Regiment of Foot and was at the Siege of Wismar a Town in the Territories of Meclenburg then belonging to the Sweeds which was taken by the Danes in the said year in the month of December. 1675

Was orderd from the Army with a Detachment of Foot on board the Fleet, A Battle was fought with the Sweeds near Oeland in the Baltick the 11th of June wherein the Danes obtained a compleat Victory. With the aforesaid Detachment in the Month of July we landed in Schonen and joyn'd the Danish Army at the siege of the Castle at Helsingborg which place the Danes took from the Sweeds in the said month by Capitulation. 1676

March'd from thence, and was at the Siege of the Town and Castle of Landskroon (*Landskrona*). One night the Sweeds made a great sally out of the Town with Horse and Foot, the Danes beat them back and followed them into the Town and took it Sword in hand. The Castle after some Days Bombardment was taken by Capitulation. 1676

1676 In the Month of August we marched from Landskroon to Christanstat which Town was taken from the Sweeds Sword in hand, some days after it was invested without opening Trenches. The Garrison did consist of near 3000 Men which were all cut to pieces. Liberty for three Hours time was granted to the Soldiers to plunder the Town where there was found a great deal of riches & Treasure. In the latter end of August, I was one of the 4000 men of the Army which march'd from Christianstat to besiege the Town Halmstat. Upon their march they were intercepted & totally defeated by the Sweeds of which number not above 700 Men made their Escape.

1676 In the Month of September several young Men that were well recommended were taken out of the Foot Regiments to be made Gunners of y^e Artillery of which I was one of the number & served as such in the great Battle fought at Lund (in the month of December) between the Sweeds and the Danes, which continued from Sun rising to Sun setting. This was counted a drawn Battle because both Army's Artillery remaind in the Field that Night.

1677 I served likewise as a Gunner in the Battle fought between the Sweeds and the Danes near Sierkiobing or Ronnenberg (*Rönneberg*), two Leagues from Landskroon in the month of July where the Sweeds had a Compleat Victory.

1677 In the latter end of the said month I was order'd with more Gunners from Schonen to the Siege of Mastrand (*Marstrand*) in Norway. In the Month of July, the Town with a little Fort was attack'd & taken Sword in hand & two other Castles near the same place was taken by capitulation.

1677 In the latter end of August we march'd with a Body of the Norwegian Army and fell in the night time on the Sweeds at Odewald (*Uddevalla*), beat them and took from them twelve pieces of Cannon & all their Baggage.

1678 In the month of September a great detachment of the Danish Army where I was one of the Number was orderd in the Expedition to the Island of Lanterugen (*Rügen*) in the Baltick. We landed on the said Island tho' we mett with great opposition from the Sweeds, and we beat them and obliged them to retire to Stralsund.

1679 I was made a Fireworker and orderd on a Survey of the Island of Sealand in Denmark.

1680 I with another Fireworker was orderd to Berlin in exchange of two Brandenburgher Fireworkers sent to Denmark to learn the difference of each Nations work relating to all sorts of Warlike & pleasent Fireworks.

1681 I was orderd to go from Berlin to Strasburg to perfect my self in all things relating to Fortification.

1682 I was order'd back again from Strasburg to Gluckstadt in Holstein where I was made Ensign in the Queens Regiment of Foot.

I was made a Lieutenant in the same Regiment & order'd with the Duke of Wertemberg, who went a Voluntier to the relief of Vienna in Austria, where I was in the Battle fought by the Germans & Poles against the Turks the 11th (*12th*) day of September. The Turks were tottally defeated with the Loss of their Artillery & greatest part of their Baggage. 1683

I was order'd with several other Engineers under Col[l] Scholten's Command to fortifie a place called Farrell (*Varel*) in the County of Oldenburg. 1684

I was order'd by the aforesaid Duke of Wertemberg who went a Voluntier to Hungary & was both of us at the Siege of Niewhausel (*Neuhäusel*) & the Battle of Gran in the Month of August. The Germans beat the Turks & took 23 pieces of Cannon with some of their Baggage; and some days after the Battle Neuhäusel was taken Sword in hand. 1685

I went as Voluntier to Hungary and was at the Siege of Buda & was recommended to Col[l] Barner Commander of the Imperial Artillery who employ'd me during the Siege in the Artillery Service, the lower Town was taken in June without Opposition, The upper Town & Castle were taken Sword in hand in the month of September. Here I got so much plunder that paid for all my Campaign done in Hungary as a Voluntier. 1686

I was made a Lieu[t.] in the King of Denmarks Drabant Guards & was employ'd as Engineer in the new Fortifications made at Copenhagen. 1687

I quitted the Danish Service on account of some Injustice done me in my promotion & went as Voluntier to Poland. I was well recommended to His Polish Majesty. I was in the Action that happend at Budjack when the Poles beat the Tarters & killed & took Prisoners to the number of 2400. Here I took for my share two Tarters prisoners which had near cost me my life by reason I would not deliver them over to a Polish Officer. 1688

IN THE KING OF PRUSIA'S SERVICE.

In the month of January I was made a Lieutenant in the Prusian Guards & the same Year went with my Col. Baron Truckis who made a Campaign as Voluntier on the Rhine. I was in the Month of March in action of Niews (*Neuss*), a little Town between Keyserwart (*Kaiserswerth*) & Cologne where the Brandenburghers totally beat the French & took all their Baggage. 1689

In the month of June was at the Siege of Keyserwart which place the Brandenburgers (after some days Bombardment) took from the French by Capitulation. 1689

In the Month of July we march'd with the Army from Keyserwart 1689

1689 to invest the Town, Bonn, which place was without intermission eight nights & days bombarded & totally distroy'd. After the Bombardment it was kept blockaded till the month of September. In this Bombardment I commanded 2 Mortars orderd me by Col[l] Wyller Commander of the Prusian Artillery.

1689 In the month of August I went from Bonn to Mentz a Town besieged by the Emperours & Allies Army In the taking of the Counterscarps or Glacies of this place it cost us near 4000 men by which means the Town was obliged to capitulate.

1689 In the month of Septemb[r] the Duke of Loraine went with 10,000 men from Mentz to reinforce the Allies Army at Bonn. By his arrival there the attack was regularly carried on in which service I was employ'd as Engineer under the Direction of Col[l] Gore, who had the direction of the Trenches carried on by the Dutch Forces. The Counterscarps or Glacies with a Ravelin & a Countergaurd were taken Sword in hand with the loss of 3000 Men. The Enemy was beat into the Town which obliged them in two days after to Capitulate.

1691 In the Month of March 8000 of the Prusian Troops were orderd to Hungary the Company to which I belonged was included in this number, we joyned the Emperours Army in the Month of June & we fought a Battle with the Turks at a place called Salankeman (*Slankeman*), where we beat them totally & took upwards of 100 pieces of Cannon with a great part of their Baggage in the Month of August.

1692 I quitted the Prusian Service & agreed with Count de Downs, for a Comp[y] of Foot, in a Regiment of Foot he was to raise for the Service of the Emperour, after some weeks spent in raising men for my Company the Capitulation broke off, because the Emperour would not agree to the Terms stipulated with the said Count.

1692 In the month of April I went from the City of Dantzick to Holland & from thence in company with some Danish Voluntiers to y[e] Siege of Namur. Afterwards to the English & Allies army in Camp at Melle, & from thence I march'd with the Army to the Camp at Genap (*Genappe*) where in the month of July I enterd as Firemaster into the English Artillery under the command of Col[l] Gore (*Goor, in Cleaveland's MSS.*).

In the English Service.

1692 I march'd with the English Artillery to the Battle of Steenkirk and after the Battle was order'd with a detachment of Fireworkers to joyn at Ostend those Artillery people which came from England under the command of S[r] Martin Beckman. From Ostend we march'd to Tourney (*Tournai*) from thence to Dixmud (*Dixmude*) & at last to Quarter at Ghent.

1693 I was commanded with a Detachment of Fireworkers & Bombardiers to Liege & from thence back again to Nearhespe (*Neerhespen*) where we fought the Battle of Landen & where our Army was beat & 63

pieces of English Cannon lost; After the Battle I was orderd with 1693 a Detachment of Fireworkers to Sasdegrand (*Sas-de-Gand*) in order to embark the great Artillery for a secret Expedition, after some days labour was orderd back again to the Army Encamped at Ninoven from thence into Flanders.

I went with my Lieut. Col[l] Brown to the Siege of Huy, which place 1694 we took from the French in the month of September by Capitulation.

I was orderd with some Mortars to follow the Duke of Wurtumberg 1695 who commanded a Detachment of the Army at Fort Knock (*Knocke*) invested by the said Duke from thence I was orderd with a Detachment of the Artillery to the Siege of Namur, which place I bombarded with 12 great Mortars & did thro' above 4000 Bombs into the Town (Cohorn's Work & Terra Nova), before the Siege was over. The Town capitulated in August & Cohorn's Works & Terra Nova in September.

Nothing material was done this Year but making Intrenchments, 1696 marching, & countermarching with the Army.

This year was like the former till we encamped at Brussels where 1697 the Cessation of Arms was Proclaimed.

In the month of September the Army marched into Quarters where 1697 the greatest part of the Artillery people were orderd to England, Forreigners excepted, who were all discharged except myself & one by name Schlunt. I was orderd to embark all the English Artillery remaining in Flanders to be sent to England, I myself went with the last embarkation the Month of Febuary.

I remained in England without being in any action. 1698-1701

I was made Major to the Artillery in the Bomb vessells sent on 1702 the expedition to Cadiz under the command of His Grace the Duke of Ormond & Admiral Rook. In this Expedition I bombarded w[th] 5 Bomb Vessells, First S[t] Cathirna (*St. Catherine*) with such success that it capitulated. I also bombarded with some Land Mortars the Fort Matagorda. At our arrival at Vigo, I bombarded with three Bomb vessells Fort Durand (*de Rande*) which was taken Sword in hand by the Land Forces. The Fleet enterd & broke the Boom which was laid over the Entrance of the Harbour near the said Fort, took & destroy'd all the Ships of Warr, Galleons &c., to the number of 37.

Went as Voluntier to Flanders, after some months stay was recalled 1703 to England in order to command the English Artillery ordered to Portugall, w[th] this present Emperour, being at that time King of Spain. Two of the Transports laden w[th] Stores under my Command were lost in the great Storm in the Downs where my self then rode, & was afterwards obliged to go to Portsmouth to repair the damage we had received by that Storm.

Nothing material done with the Army but Marching & Counter- 1704 marching.

1705 I was at the Siege of Valencia d'Alcantra (*Valencia de Alcantra*) which the English took from the Spaniards Sword in hand. At this Siege in building the Battery I had my left Arm shot to pieces.

1706 I was at the Siege of Alcantra (*Alcantara*) which place the English & Allies took by Capitulation in the Month of April here I received a contused wound in my left brest.

1706 Marched from thence to Coria & Plazencia (both towns declared for King Charles) & from thence marched to the Briedge of Almaraz (*Almarez*) & so back to Coria & to Cividad (*Cuidad*) Rodrigo, which place we besieged & took by Capitulation in the Month of May.

1706 Marched from thence to the Town Salamanca which place declared for King Charles; from thence to Madrid who likewise declared for King Charles where we encamped ten days.

1706 From Madrid we marched to Guadalaxara from thence to Guadraka (*Jadraque*), where I cannonaded (in the Month of August two days together) the Duke of Berwick's Army from thence marched back to Guadalajara & so on to S^t^ Joune (*Chinchon*), from which place we retreated into the Kingdom of Valencia where the Enemy followed us close till we had got over the pass at Raguina (*Requena*).

1707 In the month of April we marched from Valencia to the Battle of Almanza where our Army was tottally routed & the remaining part retreated to Toroza (*Tortosa*) in Catolonia. In this Battle we lost all the Portuguze Artillery & most part of the Artillery people were taken Prisoners or cut to pieces, & I had the misfortune to loose all my baggage.

1708 I commanded the Artillery on the Expedition with Major General Stanhope to the Island of Minorca where we landed in September & after I had built my Battery by which I dismounted the Cannon of two of the Enemy's Towers, built in the Line, the Castle of S^t^ Phillip capitulated in the latter end of October.

1708 The whole Island at our landing declared for King Charles & after having been 3 Months in regulating the Artillery returned back to Catalonia in the Month of February 1708/9.

1709 Marched with the Artillery to Villa Nova de la Bark (*Villa Nova de Marca*) on the River Serge (*Segre*) where I bombarded for some days the enemys Army & after our Army had pass'd the River, they took the Town Balaguer after two days siege by capitulation.

1710 In the Month of July I was at the Battle of Almenar (*Almenara*) where our Army (in less than two hours) beat the Enemy & Encamped in the place of the Field of Battle for some Days.

1710 From the Camp at Almenar we marched to besiege the Castle Moncon (*Monzon*). We possessed our selves the first night of one of the Enemys Works that cover'd their bridge laid over the Cinca River, & continued there for some days & at last was obliged to leave the place.

In August marched from thence & passed the said River near Fraga 1710
in pursuit of the Enemy to the place of Saragoso (*Saragossa*) where we fought a Battle the 20th August, got a compleat Victory & took the greatest part of the Enemys Artillery. Here I received four wounds & had upwards of 80 men killed & wounded on my Battery, & above 300 Artillery Mules hamstringed.

From this place our Army pursued the Enemy & marched to Madrid 1710
which declared a second time for King Charles. Two Months after I was carried thither & from thence order'd to Toledo to put that Artillery &c[a] (we had taken from the Enemy) in order and after some days stay was order'd to distroy the said Artillery and march to joyn part of the Army in camp at St. Joune (*Chinchon*); from whence we marched in the month of December & joyned the whole Army near Villa Vicicosa where we fought a Battle the 10th December with the loss of all our Artillery & where obliged to retreat into the Kingdom of Arragon. I was wounded with a Cannon Shott in my left Leg, lost all my Baggage & was taken prisoner in the Town of Sigüenza.

I obtain'd leave upon my Parole to go to England to be cured of my 1711
wound and after my arrival had the good fortune to be exchanged for another Colonel beloning to the Enemy.

I made pleasure Fireworks which was burnt on the River Thames 1713
in the Month of August over against Whitehall on the thanksgiving day for the Peace made at Utrecht.

In the Month of December I was order'd with a Train of Artillery 1715
to Scotland & arrived in the Month of February in the Firth of Forth by Leith where I was order'd by His Grace the Duke of Argyle to send the Vessells with the Artillery to a place called Innerkithen (*Inverkeithing*) till further orders & to march with all the Officers and Artillery people from Edinburgh to Sterling. At Sterling I was order'd by His Grace to take upon me the Command of 15 Pieces of Cannon order'd from Edinburgh &c for Field Service which was in such confusion as cannot be expressed part of which Artillery I brought so far as the Town of Dundee where I was order'd to bring the Train back again to Edinburgh by water;

In the Month of March I was order'd by General Cadogan in His 1716
Grace the Duke of Argyle's absence to send the vessells with the Artillery back again to London & the Train people to march from thence.

On our arrivall at London, I was order'd by the Board of Ordanance 1716
to lay before them Tables & Draughts of all Natures of Brass & Iron Cannon Mortars &c. which was done accordingly & approved of.

After the said Draughts 2 Twenty four Pounder Brass Cannon were 1716
order'd to be cast by Mr Bagley in his Foundry at Windmill Hill at the casting of which I was order'd to be present, In the founding the Mettall of one of the Gunns blowed into the Air, burnt many of the Spectators of which seventeen dy'd out of 25 Persons & my self received 4 wounds.

1717-18 The Board came to a resolution to regulate what was wanting to compleat a compleat Artillery for Sea & Land service, I had an order to lay before them Draughts of all natures of Carriages, Wheels, Trucks Grapes & matted Shot & all sorts of Bombs both great & small for Land & Sea Service with a great many other things relating to an Artillery too tedious to mention, which they approved off.

1717-18 I likewise laid before the Board the ill state of the Laboratory which the Board order'd me to put in some better order & to be at as little Expence as possible which I did accordingly.

1719 I was order'd on the Expedition to Vigo which place I bombarded w^th^ 46 Great and Small Mortars of my own projection which answer'd their intended end of which my Lord Cobham & the rest of the General Officers can give a better account than my self, by which bombardment the Castle of Vigo was obliged in the Month of October to surrender.

1720-22 I attended the service as formerly at all Surveys &c^a^ relating to the Artillery till such time Col^l^ Armstrong was made Surveyor, after which time notwithstanding His Majestys signifycation to me for regulating the Artillery for Sea & Land Service I was never consulted in any thing relating to the said Service.

His late Majesty was graciously pleas'd to renew my old Commission as Colonel, & to give me the Command of the Regiment of Artillery established for His Service consisting of four Companys.

An Account of the Dates of Lieutenant General Albert Borgards Commissions & by whom Signed.

Order of Commission, &c.	In what Station.	Date of Commissions, &c.	By whom Signed.
	Served one Campaign in the Artillery in Flanders as Firemaster having no Commission at that time	1692	
First	Firemaster	March, 1693	L^{d} Sidney
2^{d}	Captain & Adjutant	1st Jan^{y} 1695/6	L^{d} Rumney
3^{d}	Engineer	27 March 1698	D^{o}
4th	Major of Artillery	4 April 1702	Duke of Marlborough
5th	D^{o} Major and Commander in Cheif to Portugal	1703	D^{o}
6th	Lieut^{t} Colonel of Artillery... ...	1704	D^{o}
	both these Commissions were lost at the Battle of Almanza.		
7th	Colonel of Foot	14th April 1705	L^{d} Gallway
8th	Colonel of Artillery...	27 Nov^{r} 1706	D^{o}
	both lost at the Battle of Villa Viciosa.		
9th	Chief Firemaster of England ...	9th Aug^{t} 1712	L^{d} Rivers
A Signification	Assistant to the Surveyor of the Ordnance	25th April 1718	His Maj^{y} King Geo. 1st
10th	Colonel of Artillery Renewed ...	1 April 1722	Duke of Malbrough
11th	Ditto	1 Octo^{r} 1722	L^{d} Cadogan
12th	Brigadier General	1 March 1726/7	His Maj^{y} King Geo. 1st
13th	D^{o}	16th June 1727	D^{o} the 2^{d}
14th	Col^{l} of the Royal Regiment of Artillery	1 Nov^{r} 1727	D^{o}
15th	Maj^{r} General	28th Oct^{r} 1735	D^{o}
16	Lieut^{t} General	2^{d} July 1739	D^{o}

Abstract of all the Sieges, Battles, &c., where Lieut. General Borgard hath been present from the Year 1675.

Year.	Numbr.	SIEGES.
1675	1	The Town of Wiemar (*Wismar*) in Meklinburg
1676	2	The Castle of Helsingborg in Schonen
	3	The Town and Castle of Landskroon (*Landskrona*) in Schonen
	4	The Town of Christianstad in Schonen
1677	5	The Town of Mastrand (*Marstrand*) & Castles in Norway
1685	6	The Town of Niewhewsel (*Neuhäusel*) in Hungary
1686	7	The Town & Castle of Buda (*Pesth*) in Hungary
1688	8	The Town of Kaminic Podolski (*Kameniec—Podolskiy*) in Poland
1689	9	The Town of Keyserweert (*Kaiserswerth*) at the Rhine
	10	The Town of Bonn at Do; 2 slight wounds
	11	The Town of Mentz at Do
1692	12	The Town & Castle of Namur (taken by the French)
1694	13	The Town & Castle of Huy
1695	14	The Town & Castle of Namur (taken by King William)
1702	15	Fort St. Catherine, Cadiz; bombarded & took
	16	Do Fort Matagard (*Matagorda*), near Cadiz; bombarded
	17	Do Fort Durand (*de Rande*), near Vigo; bombarded
1705	18	The Town & Castle of Valancia de Alcantara; wounded
1706	19	The Town of Cicidad (*Cuidad*) Rodrigo
	20	The Town of Alcantara; slight wound
1708	21	Fort St. Phillip in Minorca
1709	22	Bombarded the Enemys Camp at Villa Nova de la Barca (*de Marca*) in Catalonia
	23	The Town of Balague (*Belaguer*)
1719	24	Bombarded the Castle at Vigo, which surrendred after some days Bombardmt
		BATTLES.
1676	1	Oeland in the Baltick
	2	Halmstadt in Sweden
	3	Lund in Schonen
1677	4	Rönneberg near Landskroon in Schonen
	5	Oddewall (*Uddevalla*) in Norway
1678	6	Whitow (*Wittow*) in the Isle of Ruggen (*Rügen*) in the Baltick
1683	7	Wienn in Austria
1685	8	Grann in Hungary
1688	9	Budzjack in Tartary
1689	10	Neys (*Neuss*) near Düsseldorf
1691	11	Slankeman in Sclavonia; wounded
1692	12	Stinkirk (*Steenkirk*) in Brabant.
1693	13	Near Hesp, or Landen
1705	14	Brozas in Spain
1706		Canonaded the Enemy at Guadraca (*Jadraque*) in Spain
1707	15	Almanza in Spain (where I lost my Baggage)
1710	16	Almenar (*Almenara*) in Spain
	17	Saragossa in Spain; 3 wounds
	18	Villa Viciosa in Spain; here I was wounded Lost my Baggage & taken Prisoner
1715/16		Went on the Expedition to North Britain

REMARKS

ON THE

WAR SERVICES OF LIEUT.-GENERAL ALBERT BORGARD,

THE

FIRST COLONEL OF THE ROYAL REGIMENT OF ARTILLERY.

BY

MAJOR H. W. L. HIME, R.A.,

SECRETARY, R.A. INSTITUTION.

However fully and accurately recorded General Borgard's services would always be difficult to follow, from their remoteness, their diversity, and the political complications of the times he lived in. Recorded as they are, they are bewildering to those who have the use of a good library, and must be to a great extent unintelligible to those who have not that advantage.

The existing Record, in MS., is in the R.A. Library, Woolwich; and hitherto it has been, I believe, generally received as General Borgard's autograph. Regimental tradition, however, is the only argument in favour of its authenticity. Far from being authentic, I believe the Record to be a copy made by an English clerk from a lost original, which had been dictated to another clerk by General Borgard in his extreme old age.

1. Although the Record invariably refers to General Borgard in the first person singular of the personal pronoun, it is neither signed nor initialed by him.

2. The handwriting is that of an English clerk, not that of a Dane who only entered the English Army at 33 years of age, after serving in various foreign armies for 17 years. To enable everyone to form their own judgment upon this point, General Borgard's undoubted signature to a Plate (of a gun-carriage) now in the possession of the R.A. Institution is given on the next page, and also a specimen of the handwriting of the Record. Both have been photographed on wood.

There is absolutely no similarity between the two specimens of handwriting, and there is no trace of the foreigner in the handwriting of the Record. If, consequently, the Record be accepted as General Borgard's autograph, we must be prepared to believe that the whole character of his handwriting changed after he was 31 years of age, the date of the Königsberg signature being 1690. We must also receive the handwriting of the Record as that of a man of over 80 years of age. The list of commissions given in the Record includes that of Lieut.-General, 2nd July, 1739. Now, the General was born in

Jutland on the 10th November, 1659. If he wrote the Record, therefore, he must have written it at over 80 years of age. I submit that no man of 80 ever wrote such a hand as that of the Record.

Königsborg zu Preussen d. 15 Janu. 1690. [1]

Albert Borgardt

An Account of the Battels Sieges &c. wherein Lieu.t General Albert Borgard hath served with what Time & Station and in what Princes Service as also the Dates of His Commissions during the time of His being in the English Service Viz.t

In the King of Denmarks Service

3. The variations in spelling between the body of the Record and the Tables of Battles and Sieges at the end of it are so great and so numerous, as to make it certain that the transcriber had no settled rule of spelling, and had no previous knowledge of many of the words he had to spell. General Borgard must have known the great majority of the names as well as he knew his own.

4. That but little care was taken in revising and correcting the Record may be inferred, not only from the variations in the spelling, but also from the fact that one paragraph is written twice over:—the paragraph beginning, "Marched from thence to the Corea and Plazencia," &c. This blunder is evidently that of a copyist, but it is one not likely to have been committed by a man writing out his own services.

5. The Record is full of small blunders which could not have been committed by General Borgard. Small variations in names and dates might be fairly expected, but not errors of such a character as occur in the Record. "Almenar," for "Almenara," was a common blunder,

---

[1] *Königsborg zu Preussen, die 15 Jan., 1690.*—It will be observed that the General has spelt "Königsberg" as a Norseman naturally would—"Königsborg." It will be also observed that he spelt his name German-wise—"Borgardt," just as he afterwards spelt it English-wise—"Borgard." His real name was "Borgaard," pronounced "Borgörd." Two centuries ago people were not very particular about the spelling of their surnames. Readers of Fielding will remember that the great Mr. Jonathan Wild spelt his name indifferently, Wyld and Wild.

—Defoe has so spelt it;[1] but it is difficult to account for a man who had served seven years in Spain writing "Alcantra" and "Torosa," for "Alcantara" and "Tortosa." No one who had crossed and re-crossed the river "Segre," and fought upon its banks, could possibly have called it "Serge," as has been done in the Record. "Prussia" could only have been spelt "Prusia," and it is so spelt in the Record, by an English clerk who pronounced it "Proosha." That General Borgard spelt it with two s-es is sufficiently proved by the Königsberg signature. This same signature also shows that General Borgard was particular to double-dot vowels when necessary; yet in the only four cases in which they occur in the Record,—Sierkjöbing, Rügen, Neuhäusel, and Rönneberg,—the dots are omitted. The clerks were particularly unfortunate in the double-vowels they came across:—Neuss and Neuhäusel. The first is spelt Niews and Niuys, and the second Niewhausel and Niewhewsel. This use of a "w" is fatal to the autograph theory. There is no "w" in the Danish alphabet, and "w" is consequently the very last letter a Dane would gratuitously drag into a word he could not spell. It is the very first letter that would occur to an illiterate Englishman in endeavouring to spell such words as Neuss and Neuhäusel. It is incredible that a man who was once encamped for a whole month at Chinchon in Spain should afterwards spell it "St. Jonne" or "St. Joune," as in the Record. But it is easy to believe that a very old man dictated "Chinchon," and the clerk wrote "St. Jonne." The names Farrell (Varel) and Whitow (Wittow) afford even stronger evidence in favour of the lost original having been dictated. The General naturally pronounced the "V" in Varel like a soft "f"; the English clerk at once wrote down Farrell. The General laid some stress on the first syllable of "Wittow": the clerk wrote down the purely English form "Whitow." The combination "wh" is absolutely unknown in German. How "Rügen," or "Rygen," got transformed into "Lanterruggen" is more than I can say. But it is absurd to suppose the General did not know the name of an island only a few hours sail from his own country, in which he saw active service. It is equally preposterous to suppose he did not know the name of a fort he no less than twice bombarded with success—the Castello de Rande at Vigo. This is given as "Durand" in the Record.

The clerks were not more fortunate with the names of people than with names of places. The turning of "Goor" into "Gore" may be venial; but what are we to say to the corruption of the German name "Daun" into "Downs"? No German was ever branded with such a name. Again, the German Colonel of Artillery "Weiler"—probably the Von Weiler who commanded the mounted gunners with such distinction at Fehrbellin—becomes "Wyller;" and Graf Joachim Heinrich Erb-Truchsess of Waldburg is transformed into Baron "Truckis." In fact, no single name is given correctly.

As errors have been pointed out which could only have been committed in taking down General Borgard's services from dictation, while

[1] "Memoirs of Captain George Carleton," edited by Sir Walter Scott. Edinburgh, 1808; p. 339.

others are clearly due to carelessness in copying, the only rational conclusion is that the Record we possess is a copy made by an English clerk from some lost original previously dictated to another clerk by General Borgard. The great age of the General when he dictated his services is a sufficient explanation of certain errors which must have undoubtedly existed in the original Record and which were allowed to remain uncorrected.

So much for the authenticity of the Record. It is, no doubt, a valuable document, and substantially true; but our first Colonel must not be saddled with blunders which lie at the door of two English clerks.

Since writing the foregoing remarks, I have been fortunate enough to unearth at Copenhagen a Danish "Life" of the General, the existence of which was not previously known in England.[1] This interesting and well-written *brochure* contains many new and curious facts, which shall be given in their proper places.

In order to make General Borgard's varied services more intelligible the following Tables have been drawn out, giving the Battles and Sieges at which he was present in five geographical series:—

GENERAL BORGARD'S BATTLES AND SIEGES.

I.

The Baltic.

1675	6 Nov. to 14 Dec.	Wismar.
1676	11 June	Oeland.
"	14 July	Helsingborg.
"	21 July to 13 Aug.	Landskrona.
"	25 Aug.	Christianstad.
"	28 "	Halmstad.
"	3 Dec.	Lund.
1677	14 July	Rönneborg, near Landskrona.
"	22 "	Marstrand.
"	7 Sept.	Oddewall in Norway [*Uddewalla*, in (the present) Sweden.]
1678	Sept.	Rügen.

II.

Austro-Hungary.

1683	12 Sept.	Vienna, Relief of.
1685	1 July to 19 Aug.	Neuhäusel.
"	16 Aug.	Gran.
1686	18 June to 2 Sept.	Buda.
1691	19 Aug.	Slankeman.

[1] General-lieutenant Albert Borgaard's Levnet og Bedrifter. Ved Capitain O. R. Olsen. Kjøbenhavn, 1839.

III.

Poland.

1688	24 Aug. 87 ?	Kameniec-Podolskiy.
"	1 Oct. 88 ?	Budjack.

IV.

The Low Countries.

1689	—	Neuss.
"	22–27 June	Kaiserswerth.
"	12 July to 12 Oct.	Bonn.
"	17 July to 11 Sept.	Mentz.
1692	25 May to 30 June	Namur.
"	3 Aug.	Steenkirk.
1693	19 June	Landen.
1694	18–28 Sept.	Huy.
1695	1 July to 1 Sept.	Namur.

V.

Spain.

1702	—	Cadiz.
"	12 Oct.	Vigo.
1705	May	Valencia de Alcantara.
"	—	Brozas.
1706	26 May	Ciudad Rodrigo.
"	—	Jadraque.
1707	24 April	Almanza.
1708	25 Aug. to 30 Sept.	Minorca.
1709	—	Villa Nova de Marca. Belaguer.
1710	27 July	Almenara.
"	20 Aug.	Saragossa.
"	29 Nov.	Villa Viciosa.
1719	10 Oct.	Vigo.

THE BALTIC.

The two disturbing forces in Europe, when General Borgard began his military career were Louis XIV. and the Sultan, Mohammed IV.; and for many years the former kept Western Europe, and the latter Eastern Europe in a flame. In 1668, England, Sweden, and the States-General made a Triple Alliance against Louis. In 1672 Louis bought over the kings of both England and Sweden. Denmark, which generally took the opposite side to Sweden, made an alliance with Holland in 1673. The English Parliament insisted on making peace with Holland in 1674; and the Great Elector of Brandenburg,

Frederick William, not only took the same course, but appeared on the Rhine at the head of his army. To relieve himself from this danger, Louis induced the Swedes to invade Brandenburg, and a Swedish army landed in the Mark in December, 1674. The Elector naturally hurried back to defend his dominions; and defeated the Swedes on the 18th June, 1675, at Fehrbellin, the first occasion (as far as is known) on which gunners ever appeared on horseback. Impatient at the slow pace of his Infantry, the Elector determined to send forward the Cavalry and Artillery alone, to co-operate with the troops he had upon the spot. Accordingly Colonel von Weiler was ordered to the front with 12 guns, the Gunners being mounted upon horseback. These guns, with the Cavalry, 5600 sabres, contributed materially to the success of the day. There is no known instance of gunners being again mounted on horseback between Fehrbellin and Frederick the Great's Camp at Landshut, 1759, where Horse Artillery was first permanently organized.[1]

Denmark, to create a diversion, made war upon Sweden, just after the invasion of Brandenburg; and the Siege of Wismar, which had been given over to Sweden at the peace of Munster, 1648, was the first act of the war. The Swedish Fleet was practically speaking annihilated at the sea-battle of Oeland, 11th June, 1675, by the combined fleets of Denmark and Holland.[2] One Squadron of the Fleet was commanded by the great Danish Admiral, Niels Juel; the other was under the Dutch Admiral van Tromp, son of the celebrated Admiral of that name.

The landing in Sweden was effected on the 29th June at Adstad, a seaport in Schonen, the southern provence of Sweden, anciently called Scania. Helsingborg made a very poor defence, and capitulated after a short cannonade.[3]

The defeat of General Borgard's force on the march from Christianstad to Halmstad by the Swedes, led by the king, Charles XI., in person, was the result of pure accident.[4]

Lord Macaulay, in his "History of England," speaks of Landen as "the bloodiest battle of the 17th century"; but this doubtful honour must be assigned to the battle of Lund, 3rd December, 1676. Over 50 per cent. of the two armies were killed and wounded; and, in point of loss, the only modern battles to which it can be compared are the battles of Slankeman and Zorndorf. Lund was a battle of sheer, downright slaughter. It illustrates no rule of war: the carnage is gilded by no stroke of generalship, no flash of genius. As General Borgard says, it "continued from sun rising to sun setting"; and was the battle of two wild beasts who fight until they can fight no longer.

---

[1] Taubert, "Field Artillery." Translated by Capt. H. H. Maxwell, p. 182.

[2] "Historische Einleitung zu dem jetzigen Krieg in Norden"; Frankfurth, 1710; p. 165.

[3] 'Nachdem man ein klein wenig Feuer eingeworffen hatte'; "Hist. Einleitung &c.," p. 166. Geijer, the Swedish historian, says it capitulated, 'ohne Widerstand.' "Geschichte Schwedens," translated into German by Leffler; IV., 645.

[4] Geijer; IV., 652.

The armies on either side were commanded by their kings, Christian V. of Denmark, and Charles XI. of Sweden; who showed themselves as full of brute courage as they were deficient of all the qualities of leaders. There is considerable difference of opinion among historians as to the practical result of the battle, although we cannot doubt that it was favourable to the Swedes. General Borgard, a Dane, says it was a drawn battle; and, knowing probably what different opinions were held upon the matter, gives a reason for his opinion. Dunham says that since "Christian returned to Copenhagen for new troops, while Charles succeeded in the object of the campaign,—the relief of Malmoe,—history must record the victory to the Swedes."[1] Crichton and Wheaton substantially agree with Dunham,[2] as does also the German author of the "Historische Einleitung &c.," already quoted. Captain Olsen, a Dane, admits also that the Swedes so far succeeded as to gain their object of relieving Malmoe.[3] On the other hand, Geijer, a Swede, maintains it to have been a decisive victory for his countrymen; and declares that the Danes lost 51 guns; all their baggage and ammunition; 170 officers and 2000 men prisoners. He further relates that 8357 dead bodies were collected after the battle.[4] So great an effect did the battle make upon the mind of the Swedish king, that for the rest of his life he kept the anniversary as a solemn fast, secluded in his own apartments.

The Danes owed their defeat at Rönneberg to the blind courage of their king, who on this occasion seems to have copied the behaviour of Prince Rupert at Marston Moor. The king, who commanded the Danish right, drove in the Swedish left, and pursued without any thought of what was going on behind. When at length he did return, it was only to find the day hopelessly lost, with all his Artillery and baggage, and 3000 men.[5]

The differences in the accounts of the battle of Uddevalla are irreconcilable. Geijer says the Swedish loss was estimated at 500 men[6]; while the German writer supports General Borgard in saying 12 guns were taken, and adds, 400 killed and wounded; 600 prisoners; and 18 colours.[7] Crichton and Wheaton mention that the battle was fought with *'armes blanches,'* a prolonged storm of rain having rendered the muskets useless.[8]

The taking of Rügen was the last act of the war, which was brought to a close by the peace of Nimwegen, 1679.

---

[1] "History of Denmark, Sweden, and Norway"; III., 242.

[2] "Scandinavia, Ancient and Modern"; 109.

[3] Dog havde de Svenske for saavidt opnaaet deres Hensigt at de, over Lund, kunde komme Malmoe til Undsœtning. "Borgaard's Levnet &c., p. 18.

[4] Geijer is careful to mention that his account of the battle is founded upon that of Däberg, which is preserved in the Swedish State Archives, with notes and corrections in the handwriting of Charles XI.

[5] Hist. Einleitung &c.," 172. Geijer, IV., 687.

[6] IV., 691.

[7] 173.

[8] *Ad loc.*

THE AUSTRO-HUNGARIAN WARS.

The Turks first became dangerous to Hungary in the time of the Emperor Siegmund, who reigned in the latter half of the 14th century; and Hungary and Poland soon became the bulwarks of Christendom against the Mohammedans. The long series of wars which thus began has lasted down to our own time.

It is strange that the date of the most important scene in which General Borgard figured,—one of the most important events, indeed, in modern European History,—should be given incorrectly in the Record. It is equally strange that the very same blunder should have been made in a street ballad, published on the receipt of the great news in London, which I stumbled across in the Library of the British Museum. The relief of Vienna did not take place on the 11th, but on Sunday, the 12th of September, 1683. I shall not enlarge upon this memorable event, as a full account of the siege endured by Count Stahremberg and his gallant garrison of 13,000 men, and their relief by the great John Sobieski, has already been given in one of the most readable books in the language;—"The Two Sieges of Vienna," by the Earl of Ellesmere: John Murray. Price 2s. Although scrupulously accurate, this little work reads more like a Romance than a History. It is astounding to learn, among other things, that the contemptible Emperor, Leopold, refused to thank John Sobieski for succeeding in the relief, while the Sultan put the Grand Vizier, Kara Mustapha, to death for failing in the siege; and that one of the most active traitors in supplying the Turks with information from within was an Austrian boy of 10 years of age. Caught in the act of entering one of the gates, he declared he had been visiting his parents, who had been captured in one of the suburbs and were forced by the Turks to work in the Batteries. Pitying his deserted condition he was dispatched to the Jesuits' Hospital; but on the way his mother accidentally met the party, and explained that her husband had been two years dead, and that she had never been captured by the Turks. He then declared that a certain Austrian groom had induced him to play the spy. The groom was immediately arrested, and had considerable difficulty in clearing himself of a charge of which he was perfectly innocent. It was then thought to be high time to get rid of so dangerous a character, and this precocious ruffian was put to death. Lord Ellesmere thinks flogging would have been a sufficient punishment. I beg to differ with him.

Here, as elsewhere, I have failed to gather any personal information about Borgard. He apparently was not with the few guns which were able to keep pace with Sobieski and the Cavalry in the first advance on the Sunday afternoon; for on their running short of ammunition it was a French officer who "rammed home the last cartridge with his gloves, his wig, and a packet of French newspapers." [1]

The siege of Buda, or Ofen, lasted from 18th June, until the 2nd September, 1686. Abdi, the Governor, and most of the garrison were killed. The pillage, says von Hammer, lasted the whole night, and in

[1] "The Two Sieges of Vienna," p. 142.

the morning 4,000 dead bodies blocked streets which smoked with blood and burning débris.[1] Captain Olsen points out that this was the first occasion on which the bayonet was used as the deciding weapon, by special order of the Duke of Lorraine.[2]

So great was the excitement created by this siege that all the Christian nations in Europe were represented at it, just as they had previously been at the battle of Nicopolis, fought against the Sultan Bayezid I., and at the battle of St. Gothard. Spain sent 13 Grandees—2 Dukes and 11 Marquises; there were 4 French Noblemen, 5 Italian Counts, 5 Germans of blood-royal, and several English Lords. Von Hammer gives the latter as "un fils naturel de Jacques II., un du Prince Rupert, Halifax, Granart, Monho, Cuts."[3] The natural son of James II. was probably Berwick, whom the young Queen of Spain described as "un grand diable d'Anglais sec, qui va toujours droit devant lui"[4]: the last was undoubtedly the Salamander, Lord Cutts.

At the battle of Slankeman the Turks lost the Vizier, Kœprilü, and over 20,000 men; 100 standards and 150 cannon. The Imperialists lost Duke Christian of Holstein and 6000 men. The Abbé Coyer says the only result of the battle was a fresh attack upon Lippa, "an unhappy town, perpetually taken and re-taken, and equally ill-treated by friends and foes. The very savages in the forests enjoy greater happiness."[5] Buda and Kameniec-Podolskiy, which also enjoyed the privilege of occupying important strategic positions, had a somewhat similar fate. During the 145 years Buda was in the hands of the Turks, it was besieged six times; and Kameniec was in a perpetual state of siege or blockade from 1672, when the Turks took it, until 1699, when it was given back to the Poles by the treaty of Carlowitz.

THE POLISH WARS.

Captain Olsen has cleared up the mystery attending Borgard's quitting the Danish service, "on account of some Injustice" done him. Suspecting his Major of being instrumental in stopping his promotion, he challenged that officer, and in consequence had to fly to Hamburg to avoid being tried for his life. After vainly endeavouring to obtain the King's pardon for this offence, he joined the Polish army.

We now encounter the only really obscure paragraph in the Record. According to this document he served in Poland during the year 1688, and was present at the battle of Budjack and the siege of Kameniec. Curious to say, the siege of Kameniec is not alluded to in the text, and is only given in the list of Sieges. After consulting every available source of information, I have come to the conclusion this paragraph of the Record is hopelessly corrupt. There was no siege of Kameniec in 1688; there is no such battle known as that of Budjack.

If we suppose the transcriber or copyist to have blundered about

---

1 Hist. de l'Empire Ottoman," translated into French by Hellert; XII., 199–206.

2 Borgaard's Levnet &c., p. 56. "Hist. Mil. de Flandre," p. 173.

3 "Hist. de l'Empire Ottoman"; XII., 198.

4 Cust's "Wars of the XVII. Century;" I., 54.

5 "Hist. of John Sobieski"; London, 1762, p. 450.

the date in the margin, omitting the year 1687, the siege referred to may have been the abortive operations of Prince James of Poland against Kameniec in July and August of that year. "The campaign ended," says the Abbé Coyer, "with no other exploit than the ruin of a few houses in Kameniec, and the death of 300 to 400 Budjack Tartars, who fell into an ambuscade; inconsiderable effects to be produced by so great a cause."[1] Did the transcribing clerk mistake "three or four hundred" for "two thousand four hundred," and was this the battle of Budjack?

The only military event of importance during 1688 was Sobieski's unfortunate invasion of the Bucovine, when, being overtaken by terrific floods, he had to bury his artillery on the banks of the Seret. During the retreat towards Poland, on the 1st October, 1688, a force of the Poles fell suddenly upon 2500 Tartars of the Budjack, whom they found sleeping on the ground near Soczawa, killed 1000 and made 500 prisoners.[2] Did the clerk convert this 1500 by mistake into 2400, and was this the battle of Budjack? I cannot say, and leave the reader to form his own conclusion. But this much is certain: an affair of such importance as Budjack, in which the prisoners are represented to have been 2400, to say nothing of the killed and wounded, could not possibly have been overlooked by one and all the historians whom I have consulted upon the matter, and whose names are given at the end of this paper. The Record, therefore, is corrupt and untrustworthy.

THE LOW COUNTRIES.

According to the Record, Borgard now transferred his services from the King of Poland to the King of Prussia. As a matter of fact he never served the King of Prussia, for the excellent reason that there was no King of Prussia to serve. The service into which Borgard entered in January, 1689, was that of Frederick, Elector of Brandenburg (son of the Great Elector, Frederick William), who became first king of Prussia in 1701. In the latter year Borgard had been 9 years in the English service.

It is needless to say that the wars in the Low Countries in which Borgard took part were caused by the ambition and aggressions of Louis XIV., a king whom promises could not restrain, nor treaties bind.

When Borgard speaks of Bonn being "totally distroyed" by the "eight days' and nights' bombardment," he refers to the town only. In spite of this prolonged and terrific bombardment by 140 guns and 21 mortars,[3] the gallant d'Asfeld held out for three months; and after marching out with all the honours of war, died in a few days of a wound he had received in the final assault.

There is a heading wanting in the Record for the year 1692; for in that year Borgard served at the (first) siege of Namur in the army of

---

[1] "Hist. of John Sobieski"; London, 1762; p. 404.

[2] Leugnich, "l'Hist. de la Pologne depuis Lechus jusqu' à l'année 1748"; Dantzig, 1750, p. 281 et suiv; quoted in "Hist. de Stanislaus Jablonowski, par de Jonsac; IV., 45.

[3] "Nicht zu beschrieben und gleichsam continuirliches Donnerwetter gewesen"; Feltmarechal Schonings Leben.

the King of France. At this siege the great Dutch Engineer, Cohorn, was besieged in his own fortress by the even greater French Engineer, Vauban. Cohorn's courage was as great as his skill; but all was of no avail. After being wounded himself and losing 2700 men, he capitulated and marched out, on the 30th June, with the honours of war. When Cohorn himself appeared, Vauban advanced, and invited his rival to consider himself his guest as long as he chose to remain in Namur. But the Dutchman was in no humour for such amenities. Giving a glare at Vauban, he passed on without uttering a word. The old Dutch General Winberghen, who was 80 years of age, refused to take quarter and fell, sword in hand, upon the breech. He recovered from his wounds, and was permitted by Louis XIV. to return home with a gift of two Dutch guns from the fortress. For his services at this siege, Louis presented Borgard with 1000 crowns, and offered him a Captain's commission in case he chose to remain in the French service.[1] It happened, however, that at this moment the Division of Danish troops, 7000 strong, which had served under William III. in Ireland, arrived in the Low Countries; and Borgard joined the English Army to which his countrymen belonged. "Albert Borgarde," says Colonel Cleaveland, in his 'Notes,' "entered and joined the English Artillery in Flanders (this year), at the Camp of Mille as Fire-master under the command of Colonel Goor."

The desperate determination with which the troops fought at Steenkirk is proved by one fact. Those who buried the dead remarked that almost all the wounds had been given in close fighting by the sword or the bayonet. The five English Battalions cut to pieces were Cutts', Mackay's, Angus', Graham's, and Leven's. The English Life Guards might have shared their fate, according to Corporal Trim,—"had it not been for some Regiments upon the right, who marched boldly up to their relief, and received the enemy's fire in their faces, before any one of their own platoons discharged a musket.—They'll go to Heaven for it, added Trim.—Trim is right, said my Uncle Toby, nodding to Yorick; he's perfectly right."—(*Tristram Shandy*).

Landen was the battle at which William III. behaved with such heroic courage. At the head of some English Regiments he drove back the French King's Household Troops, never before defeated: *jusqu' alors invincibles,* Saint Simon says. His two led horses were killed close to him by round shot. One bullet passed through the curls of his wig, another through his sleeve: a third bruised his side and carried away the knot of his scarf. Yet he could not be pursuaded either to conceal the blue riband of the Garter, or to wear the cuirass that others wore. On more than one occasion he threw himself, sword in hand, upon the enemy. Four times he dismounted to put heart into the Infantry. When beaten and compelled to retreat he was seen at the head of two English Regiments, and fought seven with these two

[1] The authority for this statement is the Revd. Albert Michelsen, Borgard's brother-in-law, in a letter to Herr Holt, dated London, 2nd March, 1767, which is given in Olsen. As nearly every verifiable statement in this letter is wrong, the statement in the text as to the Captain's commission and the 1000 crowns must be taken for what it is worth.

in sight of the whole Army, driving them before him above a quarter of an hour.

The Artillery gained no glory at Landen. The King attributed the loss of a large train to Gourlon, who commanded his Artillery, having ceased firing at the wrong moment. Gourlon pleaded the orders of a General Officer, which orders, however, the General denied having given. It was after this battle that Corporal Trim was left wounded on the field, and was nursed by the Beguine.

In this terrific battle the French lost 8000 out of 70,000 men; the Allies 12,000 out of 45,000. Borgard says 63 guns were lost: the French claim 76 guns and 8 mortars. Notwithstanding the fact that the French gained the day, the Dauphin had good reason to say:—"*un ou deux avantages de cette nature suffisaient pour ruiner le royaume.*"

The second siege of Namur is celebrated in many ways. After the capture of the place in 1692, Vauban improved and strengthened the fortifications with all the resources of his art. When William III. besieged the town in 1695, Cohorn was his Engineer; and so elated was he at prospect of recovering it, that he bet the Elector of Bavaria 400 pistoles the place would fall by the 31st August, New Style. He lost his bet, but only by a few hours. This was the first occasion, since France had Marshals, that a French Marshal delivered up a fortress to a victorious enemy. Marshal Boufflers marched out with all the honours of war, drums beating, and ensigns flying.

General Borgard was at both sieges.

It was at the latter siege that an English storming party, under Lord Cutts, nicknamed Salamander from his almost miraculous escapes under fire, advanced with such splendid courage, that the gloomy William for once forgot himself, and laying his hand upon the shoulder of the Elector of Bavaria said,—Look, look at my brave English!"

The fighting was desperate, and in the attack upon the Citadel, the loss of the 18th Foot amounted to the Lieut.-Colonel, 4 Captains, 7 Subalterns, and 86 N.-C. Officers and men killed; and the Colonel, 4 Captains, 8 Subalterns, and 185 N.-C. Officers and men wounded. For their gallantry the King conferred upon the Regiment the title of the "Royal Regiment of Foot of Ireland," and the privilege of bearing his own arms upon their colours, "the Lion of Nassau;" also the "Harp and Crown," and the motto "*Virtutis Namurcensis Præmium.*"

It was here again that Mr. Michael Godfrey, Deputy Governor of the Bank of England, was—to use a cant phrase, invented at the time—Godfreyed. Dispatched to the King upon some financial business, he must needs adventure himself under fire, in order to see what real war was like; and while the King was rebuking him for his foolhardiness, a cannon ball laid him dead at the King's feet.

Finally, it was at this siege that Captain Shandy received the immortal wound in his groin.

SPAIN.

We now reach the War of the Spanish Succession.

The expedition to Cadiz, 1702, is an operation upon which we cannot look back with much satisfaction. "The event shows," says

Archdeacon Coxe, "that the object of the Commanders was plunder rather than glory. The Churches were violated; the images and sacred ornaments profaned, &c. &c." In consequence the people rose, and so formidable was their opposition that after "a vain attempt to force a passage into the harbour, the troops re-embarked in disorder and disgrace."[1] The chief cause of the misconduct of the troops was drink. Port St. Mary, where the men landed, "afforded plenty of wine; and as great numbers of them did for several days partake very liberally of it (a thing too often practised and very hard to be restrained), so were the goods and merchandise of the inhabitants seized &c."[2] The whole fleet would have returned at once to England, but for the discovery, in the following extraordinary manner, of the arrival of the Spanish treasure-ships at Vigo. A number of ships, the 'Pembroke,' the 'Eagle,' &c. &c., had to put into Lagos Bay for water. Having entered the Bay, "some of the land officers, with Mr. Beauvoir, a Jersey gentleman, and Chaplain of the 'Pembroke,' went immediately ashore for refreshment. But when they came to the town, they could find nobody that could understand them; so that roving for some time from place to place, the Chaplain at length espied a gentleman who by his countenance and garb seemed to be no Portuguese, and addressing himself to him in the French language, he proved to be the French Consul, into whose favour Mr. Beauvoir so far insinuated himself, that the other offered the use of his house, both for himself and some of his friends. They lay there two nights, in which time . . . . the Consul gave the Chaplain broad hints of M. Chateau-Renaud (the Admiral commanding the Fleet that escorted the treasure-ships) being safe, not far off, with the galleons.

"In the evening, the Chaplain being informed that there was a gentleman come from Lisbon bound for the Fleet, and that he designed next morning to go on board one of the English men-of-war, his curiosity led him to send to the gentleman to acquaint him, that if he did not go on board that night he would lose his passage; since the Squadron was to sail away early next morning; and that if he pleased to go off, he had a boat at his service, and he should be welcome on board the 'Pembroke.' The gentleman having accepted the invitation, and both of them now waiting on shore for the boat, Mr. Beauvoir asked the gentleman, What news? Great news, answered the other; for Chateau-Renaud is at Vigo, with 30 men-of-war and 22 galleons; being much the same number the French envoy had mentioned to the Chaplain, whose curiosity increasing, he enquired further, who he was, and from whence he came? To which the gentleman replied, he was both a Spaniard and a German, that he came from Lisbon, was sent by the Imperial Ambassador at that Court to go on board the Fleet. . . . . That he had two letters, one for the Prince of Hesse, and the other for Mr. Methuen, Junior, which contained the particulars of that important news; for the confirming of which, he pulled them out

---

[1] "Memoirs of the Kings of Spain"; I., 224.

[2] "Complete History of the most remarkable Transactions at Sea," by Jos. Burchett. London, 1720, p. 621.

of his pocket, and showed them to Mr. Beauvoir. The latter being satisfied with the truth of what the gentleman said, and at the same time knowing that the Prince of Hesse and Mr. Methuen" had left the Fleet and sailed for Lisbon, "he had so much presence of mind as to conceal it from the messenger, lest he should refuse to go along with him, and so carried him on board the 'Pembroke,' where they found the Captain already in bed; and the messenger being tired with his long journey, went also immediately to repose himself. However, the Chaplain, impatient of discovering what intelligence he had got, bolted into the great cabin, awakened Captain Hardy, and having acquainted him with the news of the French Squadron and Spanish Galleons being at Vigo, the messenger next morning confirmed the same and produced his letters; but when he heard that the Prince and Mr. Methuen were gone by sea to Lisbon, he was much surprised, and earnestly desired to be put on shore, which the Captain agreed to."[1] Thus, by a pious fraud, the arrival of the treasure-fleet at Vigo was discovered; but we must forgive the reverend Chaplain if, for once, he permitted his patriotism to overpower his sincerity. A Council of War was held, and "a resolution instantly taken to attack an armament which offered an irresistible temptation to plunder."[2]

Borgard's transfer from Flanders to Spain in 1703 was a most unfortunate circumstance for him. Owing to this he had to share in the humiliations of Almanza and Villa Viciosa, instead of taking part in the great victories of the Duke of Marlborough. When he arrived in Spain, the English were commanded by Henri Ruvigny, Lord Galway, who was a Frenchman; while the French were commanded by an Englishman,—Berwick, a natural son of James II.

At the disastrous battle of Almanza, 24th April, 1707, General Borgard says he had "the misfortune" to lose all his baggage. He was not alone in misfortune. The Allies, some 15,500 men in all, lost *all* their baggage; *all* their Artillery; 120 standards; 5000 killed and 10,000 wounded. Las Minas, the Spanish Commander, fell severely wounded; and at his side was killed his mistress, in man's clothes. She might possibly have escaped had she worn her own clothes, like Mrs. Dalbiac, an English lady who rode unscathed beside her husband through the battle of Salamanca.[3] Among the colours taken were those of England, Holland, Brandenburg, Portugal, Lüneburg, Catalonia, Valencia, and Aragon:—a sufficient proof of the medley of nations that constituted the Allied Army.

The rival kings of Spain, Charles and Philip, first met face to face at the battle of Almenara, 27th July, 1710, which was won by a splendid charge led by the English General Stanhope, who with his own hand killed the Spanish General Amezaga, who commanded King Philip's Guards.

Those who are curious as to the nature of the magnificent "Pleasure Fireworks" made by General Borgard to celebrate the peace of Utrecht, 1713, will find an account of them in Danish in Captain Olsen's book,

---

1 "The Field of Mars." London, 1801, Art. "Vigo."

2 Archdeacon Coxe.

3 Napier's "Peninsular War;" IV, 276.

p. 139, or in German in the "Theatrum Europæum, Tom. 20, p. 445." A special pamphlet, which I have not seen, appeared in London at the time entitled, "A Representation of the *Royal Fire-Work*, performed by the directions of Coll. Hopkey and Coll. Borgard on the River Thames &c."

With the expedition to Vigo, in 1719, ended the varied and extraordinary services of General Borgard. He had served as a volunteer in the Polish, Austrian and French Armies, and had held commissions in the Danish Life Guards, the Prussian Foot Guards, and the English Artillery. He had made war all over Europe,—from Sweden to the banks of the Danube, from Kameniec to Cadiz. He had witnessed the dull, dreadful butchery at Lund; he had seen William at the head of the two English Regiments fight the seven French Battalions at Landen. He knew John Sobieski; and was probably present in the Cathedral of Vienna on the Sunday following the Relief, when the Austrian clergyman chose as his text, "There was a man sent from God, whose name was John." He was among the flower of European chivalry collected at the Siege of Buda. He was present when the Grand Vizier, Kœprilü Mustapha, was killed leading on his army at Slankeman :—when King Charles lost a kingdom at Villa Viciosa. He saw Lord Cutts lead the Forlorn Hope at Namur, and Lord Stanhope cut down the enemy's General at Almenara. He was with Prince Eugene at Vienna: he met Lord Peterborough in Spain. He cannot have been unknown to Prince Charles of Lorraine and Prince Louis of Baden, the two best Generals of the Empire: he was well acquainted with John, Duke of Marlborough. He served under the immediate command of both Vauban and Cohorn; and he sailed and fought under the two greatest Admirals of the day,—his countryman, Niels Juel, and Sir George Rooke, the captor of Gibraltar.

The repeated allusions to plunder in the Record may possibly raise a suspicion that the General was an unscrupulous marauder. No suspicion could be more unjust. General Borgard lived in times when plunder was universally looked upon as a legitimate accompaniment of warfare; and plundering was no more considered dishonourable then, than levying a "War Indemnity" is now. One fact has happily come down to us which proves beyond doubt that he was a man of strict integrity. When Colonel of the Regiment he "gave up the Cloathing to the Board of Ordnance, that he might not be suspected to have any Profit by it. He chose the Patterns, but handled not the money, but took care that all the money was laid out upon the men."[1]

Denmark, although a small country, has produced many distinguished men: not the least among them is Albert Borgaard.

The General was twice married, and had several children, all of whom died in early life. He himself died on the 8th February, 1751,

[1] Pastor Albert Michelsen to Herr Raadmund A. Holt, in Captain Olsen's "Borgaard's Levnet &c.," p. 180.

aged 91 years, and was buried in the Danish Church which once stood in Wellclose Square, and which he had been foremost in founding.

The inscription on his gravestone was :—

ALBERT BORGARD, ESQUIRE,

LIEUTENANT-GENERAL OF HIS MAJESTY'S FORCES,

COLONEL OF THE ROYAL REGIMENT OF ARTILLERY.

DIED 8th FEBRUARY, 1751,

AGED 91 YEARS.

General Borgard is always called "The Father of the Regiment," apparently for the sole reason that he was the first Colonel of the Regiment. The first Colonel of the Regiment might be fairly called "the Father," for that, if for no better reason. But it is almost certain that General Borgard was, not only the first Colonel, but (in conjunction with Colonel Hopkey) the first organizer of our Regiment,[1] the first organizer of our Ordnance,[2] and the first organizer of the Woolwich Academy,[3] originally intended for the education of Officers and Bombardiers. With good reason, then, has his countryman, Captain Olsen, called him, not only the Father of the Regiment, but the Gribeauval of the English Artillery.[4]

---

1 Olsen says the first proposal for the organisation of the Artillery in a Regiment, the joint work of Hopkey and Borgard, was laid before Queen Anne just before her death, which put a stop to any action being taken in the matter: p. 141.

2 See Appendix B.

3 Although Olsen gives no authorities for this statement, I have no doubt it is correct. The Master General was the head, but only the nominal head of the Academy.

4 "Han blev saaledes den egentlige Skaber af det engelske Artillerie, og var for det, hvad siden Gribeauval blev for det franske."—"*Borgaard's Levnet,*" *&c., p. 147.*

APPENDIX A.

List of Works relating to the Polish Wars.

Account of Poland; by de Hauteville. London, 1698.

Polish Manuscripts; by Dalérac. London, 1700.

Turkish History; by R. Knollis. London, 1701.

A. C. Z. Epistolarum Historico &c.; by Zaluski. Brunsbergæ, 1709–11.

Uebersetzung der Algemeine Welthistorie; by S. J. Baumgarten. Halle, 1744.

Scriptorum rerum Polonicarum &c.; by Knochio. Dantisci, 1753.

History of Growth, &c., Ottomon Empire; by Kantemir. London, 1756.

History of J. Sobieski; by Gab. F. Coyer. London, 1762.

Chronologischer Auszug der Gesch. von Pohlen; Aus dem Französischen, F. A. Von Schmid, by J. H. Groot. Riga and Mitau, 1768.

Fastes du Royaume de Pologne; by d'Orvelle. Paris, 1769.

Histoire de Jablonowski; by de Jonsac. Leipsig, 1774.

Hist. Belli Cosacco-Polonici; by Sam. Grondski. Pesth, 1789.

Geschichte der Ukrainischen und Sup. Kosaken; by J. B. Scherer. Leipsig, 1789.

Geschichte der Ukrainischen, &c.; by Carl Hammersdoerfer. 1789.

Geschichte Polens; by Carl Hammersdoerfer. Dresden, 1792.

Hist. de la Tauride; by Siestrzeucewicz Bohuz. Brunswick, 1800.

Tableau de la Pologne; by Chodzko. 1831.

Hinterlassene Werke; by C. von Clansewitz. Berlin, 1832–37.

Geschichte der Goldenen Horde; by Hammer-Purgstall. Pesth, 1840.

Hist. du Roi J. Sobieski; by Salvandy. Paris, 1844.

Hist. de Pologne; by Joachim Lelewel. Paris, 1844.

Historya Polska. Warzawa, 1862.

Life of John Sobieski; E. H. R. Tatham. Oxford, 1881.

A new Mapp of the Estates of the Crown of Poland; Map of Poland, by R. Morden. London, 1700.

Atlas Historique de la Pologne; by Plater. Posen, 1827.

APPENDIX B.

List of Documents by General Borgard in the R.A. Library, Woolwich.

1. Powder for proof, services, salutes, scaling and priming for the undermentioned nature of Cannon (42, 32, 24, 18, 12, 9, 6, $5\frac{1}{4}$-Prs.),[1] 4, 3, 2, $1\frac{1}{2}$, 1 and $\frac{1}{2}$-Pr. Caliber) according to the new regulation by Coll. Borgard, 1718.

2. Powder and leaden balls for proving the undermentioned small arms, (Muskets, Carabines, Pistolls, Blunderbusses, Musquetoons) according to the new regulation by Coll. Borgard, 1718.

3. A Table calculated to find the true proportion of powder for proof, services etc., according to the strength of metal in the brass and iron Cannon, by Coll. Borgard, 1717.

4. Length and Breadth of paper and parchment cartridges, proportionable to the quantity of powder for service, for the following nature of Cannon, according to the new regulation by Coll. Borgard, 1718.

5. Table to find the windage of Cannon, by a given Diameter of the bore, or ball, by Colonel Albert Borgard in the Year 1725 (with many figures and constructions).

6. Colonel Borgard's general Table for brass Cannon, proportioned by feet and inches, caliber- and ball-measure, in 1715.

7. Table of dimensions for the undermentioned nature (42, 32, 24, 18, 12, 9, 6, 4 and 3-Pr.) of Diameters for iron shot and cannon bore, by Coll. Albert Borgard, 1716.

8. Table of length, mouldings breadth, metals thickness, etc., for the undermentioned nature of iron cannon (42, 32, 24, 18, 12, 9, 6, 4 and 3-Pr.) by Coll. A. B. 1716.

9. Table of length, mouldings breadth, metals thickness, etc., of brass Cannon, 1716. 42, 32-Pr., 24, 18, 12, 9, 6, 3, $1\frac{1}{2}$ and $\frac{1}{2}$-Pr.

10. Table of length, mouldings breadth, metals thickness, etc., of brass Cannon, given to the board of Ordnance in 1716.

11. Table for measuring and surveying all the parts of the undermentioned nature of brass Cannon, calculated from the draughts given to the board in 1716.

12. Dimensions, weight and value of iron work for bolsters and shafts, according to the new regulation, by Col. B., 1719.

13. Dimensions, weight and value of iron work for bodies of travelling carriages, according to the new regulation in 1719 (24, 18, 12, 9, 6, 3, $1\frac{1}{2}$ and $5\frac{1}{4}''$ Howitzer).

---

[1] Probably the $5\frac{1}{4}''$ Howitzer.

14. Dimensions of iron work for ship carriages, according to the new regulation, December 21th 1719 (42, 32, 24, 18, 12, 9, 6. —5¼″ Howitzer).

15. Dimensions, weight and value of iron work for the following nature of brass mortars bed according to the new regulation 1719 (13, 10, 8 and 7″ Royal Cohorn).

16. Dimensions of extrees (axle-trees?), shafts, bolsters, etc., by Coll. B., January, 31th, 1717.

17. Dimensions of clear timber with the value of workmanship for travelling carriages, hind wheels and extrees, for the undermentioned nature of Cannon according to the regulation by Coll. A. B., 1717 (24, 12, 6 and 3-Prs., Howitzers, Block- carriages).

18. Dimensions of clear timber, etc., for fore wheels, 1717.

19. Dimensions of clear timber, etc., for hind and fore wheels, 1717.

20. Particular Dimensions of the scantlings of oak timber for standing carriages for the following natures of iron Cannon: 42, 32, 24, 18, 12, 9, 8, 6, 5¼, 4 and 3-Pr.

21. Dimensions of plank wheels and extrees of oak for standing carriages: 42, 32, 24, 18, 12, 9, 8, 6, 5¼, 4 and 3-Pr.

22. Scantlings and price of oak timber for standing carriages, plank wheels and extrees for iron Cannon to the regulation, 1718.

23. Dimensions, weight and value of iron work for standing carriages, 1719.

24. Solid construction and value of ship carriages of elm timber of the several natures according to the dimensions in the table.

25. Table for piling shot and shell.

26. Drawings of Artillery.

27. The Diameters of the several spheres in inches and decimal parts.

28. Table for examing the sphericall.

29. Scale from 1 dram to 39 pound one ounce.

30. Do from one ounce to 625 pound.

31. Do „ one pound to 10,000 pound.

32. Table for bores and windage of Cannon.

33. Table of Diameters of Iron Shott in inches and decimall parts divided into sixty four equall parts by Brigadier Borgard.

34. Table of Calebres of Canon in inches and decimall parts &c.

35. Specifick Gravities of Bodies &c.

36. Density of Bodies.

Borgard (Coll. Albert, R.A.), tables of the dimensions and charges of brass and iron Cannon, for land and sea service, and their carriages. Large folio. M. S. 1715–25.

Borgard, Transcript of part of the above, with tables of piles of shot. 8vo M. S.

Borgard, Tables for piling shot or shells and for finding the contents of rectangular piles. 8vo M. S. 1724.

Borgard, Tables of the diameters of spheres of lead, gun metal, iron, Portland-stone and gunpowder, to the weight of 1024 lb., and of the bores and windage of Cannon, and the diameters of iron shot, with a table of the specific gravity of bodies, 8vo M. S. circa 1740.

Table ou description des principales villes, avec leur fortification et situation de l'Europe (doubtful).

Tables of the prices of one Pound, ¼ hundred Pound, one hundred and one Ton of weight, calculated from $\frac{1}{128}$ parts of a Farthing to 18d a Pound, by Coll. Albert Borgard, 1725.

No. 1. A Table for gages and cannon-bore for the several natures undermentioned; their diameters being divided into inches and 1000 parts of an inch. Calculated by Coll. Borgard in 1717.

No. 2. Dito Dito Dito.

A Table shewing how to find mechanically the windage of the undermentioned nature of Cannon by their given diameters, which will be answerable to the foregoing Tables No. 1 and 2.

Common length of feet, inches, and decimal parts of inches, according to the number of ball.

Table of divisions of diameters for iron shot.

Table of divisions of diameter for cannon-bore.

Coll. Borgard's general Table for brass Cannon, proport., by Ft and Ins, Caliber and Ball-measure.

Table of dimensions of metal-thickness, mouldings breadth, &c., for the undermentioned nature of iron Cannon, for Sea service, according to the draughts.

A Table for finding the number of round-shot contained in any regular pile.

A Table how to find the length of the two sides of any square or parallelogram for piling any given number of Cannon shot or shells.

A FLYING VISIT TO THE CRIMEA,

BY

CAPTAIN F. BEAUFORT, R.A.

I MUST preface this short notice by saying that, owing to the necessity I was under of not overstaying my leave, my visit was but a very brief and hurried one.

Returning home from Baku, to which place I had journeyed in the vain hope of being able to cross the Caspian and follow the new railway on to Kizil Arvat, which project, owing to the utter want of *rapport* between the time tables of the steamers and those of the railway, I had most reluctantly to give up, I landed about 2 p.m. at Sebastopol. Having changed into suitable apparel at the Grand Hotel, which is close to the landing stage, I started off map in hand. The maps I used were those belonging to Russell's "Expedition to the Crimea," which I found very fairly accurate. I first of all made for the Malakoff; reaching this point I had a capital view of the harbour and of the surrounding country. "Orienting" myself there, I had no difficulty in making out the lines along by the "Little Redan" to the "First Bastion." Walking across thence to the Mamelon, I was able to make out very fairly the French approaches, which are still wonderfully well preserved. Descending thence to the point marked on Russell's map as the junction of the British and French Trenches, I was able to trace the former as far as "Battery XV.," from whence, following the "Woronzoff" ravine, I crossed over by the "Quarry" to the "Redan." I was much assisted in making out the approaches here by the remarkable state of preservation of the approaches on the right of the British left attack, which were plainly visible across the Woronzoff ravine; Russell's map being very accurate here. As it was now getting dark I went home by the "Barrack Batteries."

Hiring a horse, I started the next morning at 9 a.m., and rode out by the Balaclava Road, calling, *en passant*, on the Artillery there in camp. Debouching from the "*Col de Balaclava*" and following the left hand road at the fork, you gain the southern portion of the battlefield, viz., that on which took place the charge of the Heavy Cavalry; a large portion of the ground over which the charge was made is now occupied by an extensive vineyard. Having "made out" the ground, I descended to the harbour and fed myself and my rather sorry steed at a neat little Restaurant on the beach. Here I had the pleasure of meeting

Colonel Count Milutin, Commanding a Regiment of Cossack Horse, encamped in the neighbourhood, with several of his Officers, who seemed to use the Restaurant as a Mess-house. They interested themselves very kindly in my travels and gave me some information as to the best road to take so as to see Inkerman.

I left the village by the road leading by the rear (as shown on the map) of the Russian Cavalry, visited Redoubt No. 4, which is well preserved, and the monument near it, and then rode across the line of the "Charge of the Six Hundred." A comparatively narrow valley, commanded on three sides, and destitute of any cover—the charge of our Cavalry, even taking into consideration the difference in the armament of the opposing force, to my mind fully equals, if it does not surpass, the feat of Bredow's Brigade at Mars-la-Tour.

Leaving the field of Balaclava, I followed the road through the Pass in the Tedionkine Heights to the Traktir Bridge, the scene of the fight of the 16th August, and following the road by the northern bank, reached Inkerman, where I had an opportunity of inspecting the remains of the extraordinary cave-city of the Scythians, with the curious little church cut out of the perpendicular cliff. Thence, following the river for about three quarters of a mile, I crossed by a bridge rather to the east of that shown as "Inkerman Bridge." Instead then of sticking to the "Post Road," I stupidly attempted to make a short cut for myself up the side of the hills, and lost in consequence some valuable time. The Post Road lends itself admirably to the task of seeing the battle field, passing as it does through the scene of some of the hardest fighting. It was now late so I made the best of my way to the hotel.

The next day, as the boat for Odessa did not leave till 3 p.m., I drove out to Cathcart's Hill, and had a look at the Cemetery. Gunners will be glad to know that all or nearly all the R.A. monuments are, in common with the rest of the cemetery, kept in very fair order, owing to the patriotic endeavours of the British Vice-Consul, Captain Harford.

Being obliged to leave that afternoon, I was unfortunately unable to see the Alma.

BATTLE FIELDS

IN THE

LE MANS CAMPAIGN.

BY

CAPTAIN R. F. JOHNSON, R.A.

No. 4.

CHAHAIGNES.

9th January, 1871.

The site of the combat at Chahaignes, fought by the left German Column on the 9th of January, can be visited on the way to Le Mans from Vendôme by the Pont-de-Braye line, which did not exist in 1871.

After running round the bend of the Loir below Vendôme on the south bank, the railway cuts through the spur of high ground, round which the river winds by Gué du Loir, and Thoré station is soon reached. Just beyond there is a small ravine in the steep slopes on the left of the line (S) which runs up to La Saulnière Farm, from both sides of which the German guns shelled French troops on the 6th January as they were moving northward on the other side of the river towards the combat, which was going on near Gué du Loir; the range was long, and the result was probably a waste of ammunition.

A little further on the line passes in a short tunnel under the right of the Artillery position, occupied on the same day to cover the passage of the Loir by the German left Column. After passing the tunnel, a line of heights is seen stretching southward as far as the mouth of a valley running up from the south-east, marked by the ruins of the old Castle of Lavardin. All this position was occupied by guns, which completely commanded the low right bank of the river towards Montoire, and rendered resistance to the crossing impossible; an instance of the great value of Artillery.

Montoire lies in a flat, open plain commanded by high banks, covered with wood on the left bank, while the right bank of the valley lies somewhat to the north and has a gentle slope.

Soon the valley narrows, and the right bank becomes steep and dominates the other. From Troo to Sougé the road and railway run

close to the river under steep cliffs, and the country here becomes much enclosed; this is ground to be remembered by the Germans, for on it a considerable party was surrounded on the 27th December, 1870, and only succeeded in cutting its way eastward with considerable loss (an account of this affair is given in No. 121 of the "U.S.I. Journal," 1883).

By Pont de Braye the valley opens out and the banks are not so steep, but the enclosures are small and there is much timber. At Ruillé-Poncé station the railway is alongside the road, on which, on the 8th of January, some mitrailleuses placed on the slight rise near Ruillé did much execution on the head of the German column; the slopes on the right (N) of the road are not steep, but the state of the ground probably confined the march to the road.

Leaving Ruillé, the river and railway cross the valley to the south side. Due north lies the large Gidonnière Château in the midst of trees; north-west is the broad mouth of the valley of the little river Venne, called the Brives in the German official account. Soon L'Homme is passed on the right, a fair-sized village (950 inhabitants) in the midst of trees, lying just east of the junction of the Venne and Loir. The valley now turns south-west; all its bottom being thickly timbered and cut up into small enclosures divided by large hedges, while the steep high slopes on both sides are covered by continuous vineyards. Chahaignes station is about three-quarters of a mile from the village.

Chahaignes is a large village (1400 inhabitants), built slightly above the main valley at the mouth of a narrow but deep one coming from the north; it contains a number of large well-built houses and a fair-sized church. At the church turn to the right, E.,[1] and follow the road along the foot of the slopes to the point marked La Brunière on the maps, where the road to L'Homme branches off to the right. Here turn to the left up an "occupation" road leading to some farm buildings, and keeping straight on through these ascend the slopes by a pathway which will be found in rear of them. From the shoulder of the hill a little to the right of this path is the best point from which to see the ground covered by the combat of Chahaignes.

Before you lies the junction of the valleys of the Venne and Loir, both of which are full of trees of all sorts, and small enclosures, between which there are but few roads, such as do exist resembling well-kept English country lanes. The junction forms a large circular basin from which the Loir valley runs to the S.W. and eastward; opening out considerably in the latter direction beyond the narrower part between La Chartre and La Gidonnière Château; while that of the Venne runs northward rapidly narrowing from about 1300 yards at its mouth to less than 800 yards a mile further up. Eastward, in the far distance, the spire of Ruillé stands out against the sky, two miles away the roof of La Gidonnière peeps from amidst its surrounding trees, while La Chartre is hidden by woods at the angle

[1] Capital poached eggs can be had at the "hotel" just on the left after turning, but the wine is vinegar, pure and simple.

of the Loir valley, and in the midst of the basin lies L'Homme almost invisible, not quite 3000 yards from you. The course of the small stream of the Venne can be traced through the network of hedges by its fringe of stately poplars; and glimpses are caught of small farms dotted here and there.

The slope you are on forms the right bank of the Venne valley, and curves round towards Chahaignes, which is 1200 yards on your right rear (S.W.). Its line is unbroken from the last-named village to Le Haut Perray and the Château Benehart, one mile and a-quarter north, except at points a quarter and half a mile on your left, where small narrow ravines run up from the road at the bottom of the slope to the farms of Le Presidial and La Montrée.

The top of the bank is flat, cut up into small cultivated enclosures, and bounded to the N.W. by the end of the large forest of Bersay (or Bercé). The steep part of the slope has a round profile, and is entirely covered with vineyards, except just by Chahaignes and the Benehart Château, where there are considerable woods. Below the steep part there is a strip of open cultivated ground about 300 yards wide stretching down to the Chahaignes—Le Haut Perray road, beyond which are the small fields of the valley bottom. Below you, slightly to the left, is the farm of Les Héraudières, and low down across the Loir Valley on your right can be seen two large white buildings marking the site of Gué de la Pointe.

On the morning of the 9th of January, 1871, the French had one Battalion stretched as outposts between Gué de la Pointe and the Benehart Château (? 4400 yards) and lined the heights you are on, while four Battalions held Chahaignes village, and three more formed a reserve in rear. Two guns were posted rather to your left to take the road to L'Homme crossways, and two more with two mitrailleuses were in position just below you.

The left column of the German army had its head at La Chartre, two-and-a-half miles off, but stretched away to the rear as far as Pont de Braye and Sougé, nearly ten miles off. The troops about Pont de Braye were ordered to move directly north-west under General von Woyna, while the remainder were to advance up the Venne valley, sending a flanking party of two Battalions, two Squadrons, and six guns along the top of its eastern bank by La Gidonnière Château.

At 9 a.m., it is snowing fast and the cold is intense, when two Battalions, two Squadrons, and six guns forming the extreme Advanced Guard reach L'Homme, and the Infantry-scouts begin to issue from its north-west edge. The thin line of French outposts immediately opens fire, but the two German Battalions deploy and work their way steadily across the enclosures to the line of the Venne (Brives). Other troops continue to arrive, and eighteen guns open from the north-west of L'Homme, but the snowstorm soon destroys the view and they cease firing. The French appear to be in strength and their guns and mitrailleuses command the roads. A pause ensues in the German advance, and, the affair promising to be serious, orders are sent to von Woyna to march to the sound of cannon, while the party marching by La Gidonnière Château is directed to wheel round and

turn the French left by Le Haut Perray. These last troops, however, having failed to get their guns up the steep sides of the valley, for horses can scarcely stand on the ice-covered tracks, have given up the attempt, and followed the main column to L'Homme.

The march is being delayed, and this column of the Army is already behind its proper position in the concentric movement on Le Mans, so, while the larger part of the Artillery, rendered useless for the moment by the weather, is sent back to Pont de Braye to take the easier route followed by von Woyna, the Infantry commence to push forward on the left towards Chahaignes. Two Battalions move down the Loir Valley, but are delayed by having to build a temporary bridge across the Venne, and the troops originally engaged, reinforced by the party from La Gidonnière Château, occupy the attention of the French centre and left and edge away northward to threaten the latter by Le Haut Perray.

As soon as the Venne is bridged, the advance is again made steadily westward and Chahaignes carried, the French hastily retiring to the south-west and north-west. The victory is with the Germans, but the march northward cannot be resumed before 2 p.m., and so more than half-a-day has been lost by them, *i.e.*, gained by the French.

General de Chanzy ascribes the defeat to the action of German guns on the east side of the Venne Valley and to pressure on the left flank, and blames his subordinate for not occupying the heights of La Corbinière. The Germans make no mention of guns in this position, and the force that was to have occupied it failed to mount the hill by La Gidonnière Château. The enclosed nature of the valley, and the scarcity of communications in it, would have rendered the action of forces on either side entirely independent of one another, and the French strength was not sufficient for such a division. In this instance, as in several others, General de Chanzy appears to have received incorrect reports, which renders his account of engagements at which he was not himself present very unreliable.

The nature of the ground in rear and on the left can be seen by striking across country to La Montrée and then turning to the right down the ravine to the Chahaignes road.

On the way to Le Mans the Tours-Le-Mans railway is joined at Château de Loir, and runs thence by Ecommoy and Arnage, the latter marking the right of the French line of battle during the 10th, 11th, and 12th of January. This line of communications was not cut by the Germans until the evening of the 11th, but the French appear to have made little use of it after the 9th, fearing to risk their rolling-stock.

(*To be continued.*)

PRÉCIS
AND
TRANSLATIONS.

RUSSIA.

I.

THE RUSSIAN ARTILLERY JOURNAL,

February, 1884.

BY

LIEUT. J. M. GRIERSON, R.A.

THE following are the remarks made on Watkin's range-finder at the trials made with it in Russia at the Okhten range :—

"The experiments were carried out with a view to ascertaining :—

1. How the range-finder worked in practice;
2. What was the greatest range which could be taken, and
3. What was the mean error made in taking ranges.

As regards the first point the only complaints were that the instrument was rather heavy, and that moving from A to C, and from C back to A, took up a good deal of time; otherwise the working was satisfactory.

The longest ranges which could be taken, even using the telescope attached to the instrument, and with very favorable weather, was 1500 sagènes[1]. In cloudy weather, and if the object were badly defined, this distance would be greatly reduced.

The mean error of separate observations was :—

At a range of	500 sagènes	(base 36 sagènes)	...	3 sagènes.
"	1000 "	" 32 "	...	11 "

These errors are so small that they may be neglected, and one could not desire more accuracy.

The time required to take a range varied between 4 and 7 minutes.

[1] 1 sagène=7 feet.—*J.M.G.*

The arrangement by which the instrument measures its own base without the aid of a chain or steel tape must be considered as one of its most important features, and irregularities of ground have thus no influence on the accuracy of the measurement. Even rivers and ravines, if they only can be crossed, are no obstacles to measurement. It is probable that by using the Watkin's range-finder any base could be measured more quickly and exactly than by a chain.

The very short ranges which only can be taken make us doubt the suitability of Watkin's range-finder for Artillery, but for Infantry there can be no doubt but that it would be of great use."

The following account of the exercises in arming batteries in a fortress, and firing by night, executed by the Novogeorgievsk Fortress Artillery may be of interest.

"The following were the exercises in arming batteries :—

1. 6 sergeants and 90 men of the 2nd Battalion under the command of two officers, were to place three 12-pr. cast-iron guns, and three 24-pr. short cast-iron guns, on carriages of the 1877 pattern in battery on the covered way.

2. 10 sergeants and 150 men of the 1st Battalion under the command of two officers, were to place six 6-inch rifled guns in battery on the Warsaw curtain. The guns were to be drawn by tackles and drag-ropes.

3. 2 officers, 12 sergeants, and 192 men of the 4th Battalion, were to place four 8-inch guns strengthened with rings in the masked battery, 120 sagènes from the rampart, beyond the Warsaw Front.

4. 2 officers, 8 sergeants, and 120 men of the 5th Battalion were to place four 8-inch cast-iron mortars in the masked battery, 50 sagènes from the rampart of the Warsaw Front. All the platforms were to be of the pattern of 1876. To transport them, 8 two-horsed carts, (two per battalion) were allowed.

The park was placed about 100 sagènes from the nearest battery, and more than half a verst (600 yards) from the most distant. The battalions were not allowed any extraneous aid.

On the completion of the armament of the battery, it was to be prepared for action, and a round of blank ammunition fired from each gun. The armament began at 9.30 a.m., in favorable weather. The guns were taken along a chaussée (which was covered with mud after recent rain), only the 8-inch guns being taken across country.

In 2 hours 25 minutes from commencing work, the first six shots were fired from the battery of the 2nd Battalion, followed 25 minutes later by those from the mortar battery. The 8-inch guns fired a salvo $3\frac{1}{4}$ hours after beginning work, while the 6-inch battery, in consequence of some delay which took place, did not fire till a quarter of an hour later. Thus, in $3\frac{1}{2}$ hours all four batteries of, in all, 20 guns had been armed.

The exercise of arming batteries by night and firing by night were carried out by the Novogeorgievsk Artillery, with the same success as those by day, the only difference being that at night the works were illuminated by the electric light. At all exercises, telephones and range-finders were used, and nothing was of such assistance to the shooting as the fact of the points of impact of the projectiles being communicated to the battery by telephone. To show what excellent use was made of all auxiliary apparati (electric light, telephones, light rockets, &c.), we shall give here the results of the night firing carried out on the 27th September. The idea was that an enemy besieging the fortress had resolved to capture our counter approaches, and was for this purpose moving forward a thick chain of skirmishers, with supports and reserve, supported by the fire of a field battery and some cavalry. The Commandant of the fortress hearing of the proposed attack, had ordered the electric light apparatus and light rockets to be got ready, and four field guns to be placed on the glacis to the right of our works. These guns (two 9-pr. and two 4-pr. bronze guns) were to fire at targets arranged as follows:—at 350 sagènes from the battery was the skirmishing chain, (50 figure targets), at 400 sagènes and to the right of the line of fire, an Infantry reserve (a wooden target 25 arshins[1] long and 2½ high); at 450 sagènes and to the left of the line of fire, a 4-gun battery with detachments (28 figure targets), and at 500 sagènes and to the right, the Cavalry, (a wooden target 22 arshins long and 6 feet high). Each gun was supplied with 10 rounds of common shell and 15 case.[2] The firing lasted 50 minutes, and the results were as follows:—

In the skirmishing chain, 35 figures hit in 181 places.

In the reserve 590 hits.

In the hostile battery, one gun put out of action, and three figures hit in four places.

In the Cavalry 197 hits.

The targets were illuminated by the electric light and star rockets. The telephone and range-finders were also used."

By an Imperial order dated 2nd December, 1883, the Eastern Siberian Artillery Brigade has been increased by a 4th Mountain Battery, having the same strength as the 3rd Mountain Battery.

---

[1] 1 arshin = 28 inches.

[2] So in the original.—*J.M.G.*

SWEDEN.

I.

ON THE

MEANS OF SPARING DRAUGHT ANIMALS:

(*Apparatur afsedde att spara dragarne*).

A LECTURE DELIVERED IN THE ARTILLERY CLUB, STOCKHOLM:

BY

LIEUT. G. FRUMERIE, SWEDISH ARTILLERY.

Printed by permission.

BY

MAJOR H. W. L. HIME, R.A.

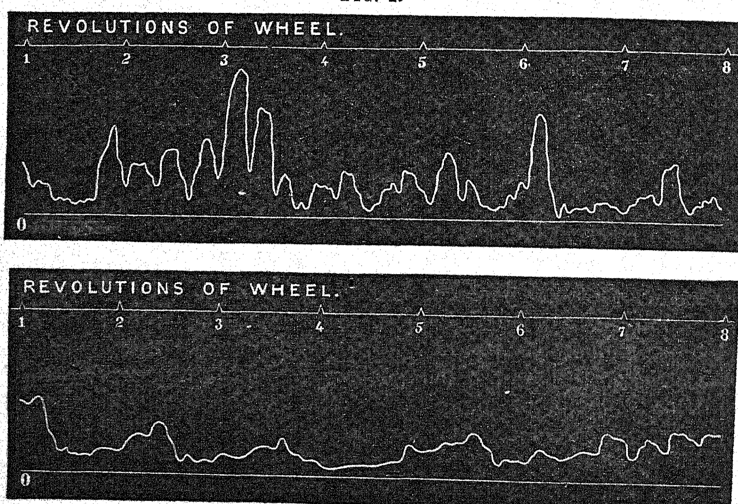
THE following is the substance of Lieut. Frumerie's Lecture, which accompanied the 3rd Number of the *Artilleri-Tidskrift* for 1884.

The forward motion of a man's or a horse's body is not constant; and the irregularities in the motion are greater at slower, and less at quicker paces. During the moment after lifting a foot, the forward motion of a man's body is greater than during the previous moment, the motion becoming slower until the other foot is raised. This is more observable in the horse, which may be regarded as two two-footed animals together. The line described by a man's or horse's centre of gravity, when moving, is not a right line drawn through the animal's centre of gravity, parallel to the ground. It is a curve, or a series of curves, which deviates more from a straight line as the pace increases. Hence the angle of draught varies from moment to moment, being a maximum when the centre of gravity is at the highest point of the curve. In addition to all this, the weight moved loses, every instant, a portion of the velocity imparted to it by the means of draught, from the various resistances it encounters. Hence when a weight is drawn along a road, the velocity of the weight and the motor power is not the same at every instant. The draught, then, is in reality a series of jerks, more or less irregular according to the pace and nature of the road, instead of being a sustained and equable pull. The result is loss of power and wear-and-tear to the draught animal.

To show the nature and amount of these jerks, M. Marey, Professor of Physiology in the College of France, has constructed a self-registering dynamometer, General Morin's not being suitable for such a purpose. A man was harnessed to a cart, which he drew over the level, asphalted road outside the Jardin du Luxembourg in Paris. On

examination of the dynamometer attached to the harness, it was found that the instrument had traced out a curve, the great irregularities of which showed the sudden, strong, and numerous jerks to which the man had been subjected. Elastic links were then inserted in the harness connecting the man and the cart, and the curve traced by the instrument (while the cart was being drawn at the same speed over the same ground) corresponded much more closely to a right line than in the former case. The jerks to which the man had been subjected were neither so sudden, nor so violent. Fig. 1 shows the two curves actually traced by the dynamometer, the upper one without, the lower one with elastic connection.[1] From the results thus

FIG. 1.

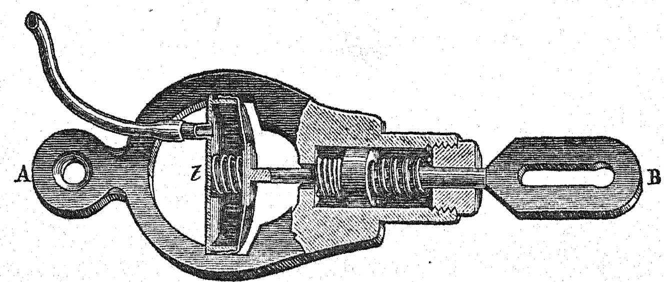


graphically obtained, a calculation was made showing the ratio of the work done in the two experiments to be 72 : 53. In other words, the elastic links had led to a saving of 26 per cent. of the work done. Furthermore, the jerks and strains, from which the man suffered considerably in the first experiment, were practically absorbed by the elastic links, especially at rapid paces. Further experiments upon hilly, stony, and rutty roads, showed even a more favourable result for the elastic links. The percentage of work saved was greater, as was also the ease with which the man drew. Fig. 2 shows the dynamometer, which consists of a stout iron frame with two loops, one to attach to the carriage, the other to the harness. This latter, B, is attached to the rod of a piston kept in equilibrium by two powerful spiral springs. The rod is continued on up to a membrane of india rubber which closes a metallic case, *t*, and which is kept in contact with the end of the rod by a spiral spring. Every exertion of draught draws out the membrane and rarefies the air in the metal box. The

[1] From a paper read at the Congress of Lille, 1874, "Du moyen d'économiser le travail moteur de l'homme et des animaux," courteously sent to me by Professor Marey, the author.—*H.W.L.H.*

air is thus rarefied or compressed according as the traction increases or diminishes. This gives rise to a stronger or weaker puff of air in an india rubber tube, connected with an apparatus which marks a revolving cylinder.

Fig. 2.



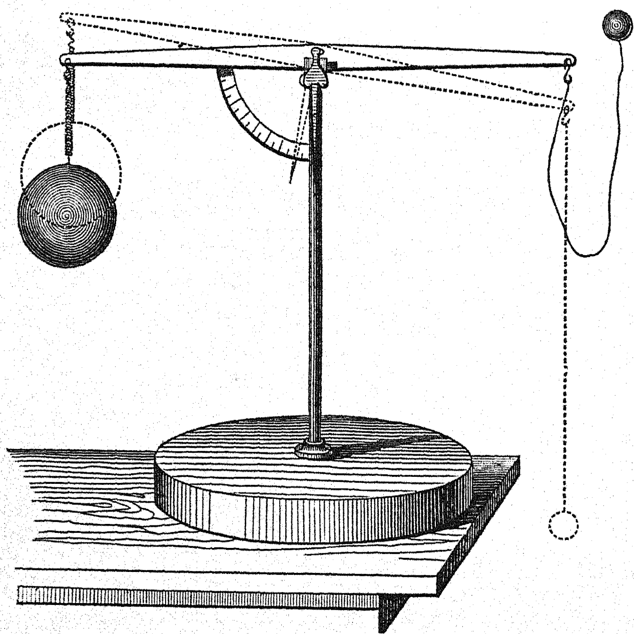
To Professor Marey belongs the honour of having been the first to prove the two advantages of elastic connexion between the drawer and the draught. First, it diminishes the jerks which weary, and eventually wear out, the horse; and secondly, it admits of a given amount of work being done with a minimum exertion of force. The Professor, it may be added, had been led to believe that such advantages existed, previous to the use of the dynamometer, from the consideration that the muscles not only enable us to control our motions, but enable us to perform a given piece of work with the minimum exertion, *owing to their elasticity*. Subsequent experiments with the dynamometer at Gefle in Sweden by Herr Sidén, fully bore out the Professor's results.

If a heavy weight, such as a block of granite, be suspended by a rope, it may be moved by a gentle pressure of the hand acting for a certain time, while it will not be sensibly disturbed by a violent blow of the fist. In the second case, a much greater force is applied to the heavy body than in the first case; but it is so applied that it is converted into, and given off in another mode of force, heat. Let some slightly compressed elastic substance be now placed between the block and the striking body, and it will be found that a large portion of the energy of the blow is communicated through the elastic substance to the heavy block. Acting upon considerations suggested by these facts, Professor Marey has contrived a simple instrument to show the quantity of work gained by elastic connections in draught. Fig. 3 shows a kind of balance in which one weight is 20 times the other, and which can revolve only *from* the greater *to* the lesser weight. The weights are at first hung by very inelastic cords, the cord attached to the smaller weight being of some specific length, say one metre. If the small weight be lifted up to the arm of the balance and let fall (through one metre), the sound shows that the whole system has received a severe shock, although the heavier weight is scarcely moved. But if the heavy weight be now hung by means of an elastic cord, and the same operation repeated, the heavy weight will be very sensibly moved:—through $2\frac{1}{2}$ to 3 centimetres, if the weights be in grammes. Thus, in the first case, by expending 5 grammes-metres of work, no useful result is gained; while in the second case, $2\frac{1}{2}$ to 3

gramme-metres of work are gained; *i.e.*, 50 to 60 per cent. The small weight represents the horse, and its fall his thrust against his collar when moving a heavy weight. This thrust is very observable in some cases:—for instance, in starting a cart off up a hill. The heavy weight of course represents the load.

The theory of this can be represented as follows:—

Fig. 3.



(1) Suppose the strings inelastic, and T the impulsive tension of each string due to the jerk of letting m grammes fall h metres; V_2 the velocity of m just before the string tightens; then,—

$$V_2{}^2 = 2gh.$$

Also, since there is no loss of momentum—

$$(M + m)\,V = mV_2;$$

and if M rises s,—

$$s = \frac{V^2}{2g} = \left(\frac{m}{M+m}\right)^2 \frac{V_2{}^2}{2g} = \left(\frac{m}{M+m}\right)^2 h;$$

so that

$$\frac{s}{h} = \left(\frac{m}{M+m}\right)^2.$$

If

$$M = 100, \quad m = 5; \ \frac{s}{h} = \left(\frac{5}{105}\right)^2 = \left(\frac{1}{21}\right)^2.$$

Also, since the momentum MV is generated by the impulse T,—

$$T = MV.$$

(2) Suppose the string by which the heavier of the two weights, M, is suspended to become elastic, and to have a coefficient of restitution e; then T must be changed into $T(1+e)$, and therefore—

$$V' = V(1+e),$$

and if M now rises s' $\qquad s' = \frac{V'^2}{2g} = (1+e)^2 s.$

For *perfect* elasticity (so called) we must put $e = 1$; and then—

$$V' = 2V; \quad s' = 4s = \frac{4}{(21)^2}.$$

The kinetic energy of M in gramme-metres is now—

$$\begin{aligned} L &= \frac{MV'^2}{2g} = \frac{2MV^2}{g} \\ &= 2M\left(\frac{m}{M+m}\right)^2 \frac{V_2^2}{g} \\ &= 4M\left(\frac{m}{M+m}\right)^2 h. \end{aligned}$$

If $\qquad M = 100, \quad m = 5, \quad h = 1;$

then $\qquad L = \frac{4 \times 100}{(21)^2} = \frac{400}{441}.$

If v' is the velocity with which m hops up, then—

$$\begin{aligned} T(1+e) &= mv' + mV_2 \\ mv' &= T(1+e) - mV_2 \\ &= M(1+e)\,V - mV_2 \\ &= \frac{Mm}{M+m}(1+e)\,V_2 - mV_2; \end{aligned}$$

or $\qquad v' = \frac{Me - m}{M+m} V_2;$

and if we put $e = 1$: then—

$$\begin{aligned} v' &= \frac{M-m}{M+m} V_2 \\ \frac{v'^2}{2g} &= \left(\frac{M-m}{M+m}\right)^2 \frac{V_2^2}{2g} \\ &= \left(\frac{100-5}{100+5}\right)^2 \\ &= \left(\frac{19}{21}\right)^2. \end{aligned}$$

Therefore if l = kinetic energy of m in gramme-metres after the jerk,—

$$\begin{aligned} l &= \frac{mv'^2}{2g} = 5\left(\frac{19}{21}\right)^2 \\ &= \frac{1805}{441}. \end{aligned}$$

The total kinetic energy is then—

$$L + l = \frac{400 + 1805}{441}$$

$$= \frac{2205}{441}$$

$$= 5 \text{ exactly.}$$

If e is not exactly $= 1$, but rather less than 1, this figure must be reduced, to 4 say.

The traction of an ordinary horse is reckoned in the Swedish Artillery at 50 kils. This is the power the horse can put forth during prolonged periods of draught. The "momentary traction" is reckoned at 400 kils.; that is the force the animal can suddenly exert in drawing a cart over, say, a very large stone.

The German Professor A. Weiss has recently published the following results of experiments he has made. The traction of an ordinary horse weighing from 350 to 500 kils., moving at the rate of 60 to 70 metres a minute, is 65 to 75 kils. An ox of 300 to 700 kils. weight, moving 35 to 53 metres a minute, exerts a traction of 60 to 100 kils. In these experiments the ground was quite level, and the time the animals were employed, 8 hours a day, exclusive of short periods of rest. An increase or decrease of 1 per cent. in the time of work diminishes or increases, as the case may be, the traction 1 per cent. As to the rate of motion, he considers that if the ordinary traction, say 75 kils., be raised to 100 kils., *i.e.*, 33 per cent., the speed must be diminished to 40 metres a minute, *i.e.*, 33 per cent., or, in the inverse ratio of the load. When horses are harnessed tandem-wise (singly, or doubly), the loss in traction is about 6 per cent. for each individual horse so placed. Thus if 4 horses are harnessed one before the other, the wheeler will exert his whole power of traction; but the loss on the other horses is $3 \times 6 = 18$ per cent. (of the traction they would have exerted if harnessed abreast).

Herr J. T. B. Sidén, of Gefle, who has also made experiments in this direction, gives the following results:—A child of 14 exerts a traction of 3 kilogrammes; a young man, or woman, 5 kils.; an ordinary labourer, 7·5 kils.; a strong labourer 11·4 kils.;—all being supposed to draw at the rate of ·74 metres the second. In case the foregoing, instead of drawing weights with their bodies, perform work with their arms only, the value of the work they do, respectively, is 67 per cent. of the foregoing figures. At the same rate, a weak horse can draw 22·7 kils.; a medium horse 37 kils.; a strong horse 76 kils. A horse with good digestive organs can exert a traction of 83·5 kils., or 1·1 machine-horse power. Oxen of the same weight as horses, can exert the same traction, but at a much reduced rate of motion. Other things being equal, a beast's power of traction varies directly as his weight. In the foregoing experiments the duration of the daily work was 8 hours. By straining a horse, the amount of work per second is considerably increased; but in a long continued series of experiments, the effects of such sudden over-straining is not observable, and they

necessitate, if frequently resorted to, diminishing considerably the daily period of work.

Fig. 4 shows Fehrmann's elastic link or "Horse Protector" (Gebr. Schwank, London, 1874). It was put to a number of trials with the dynamometer at Halle in that year, and showed a saving of work of 24 per cent.—almost the same figure as Professor Marey's. The link consists of a cylinder filled with rings of india rubber, separated by thin discs of cast-iron. When the team pull, the rings are compressed by the tension exerted by the lever hook (in the Plate), which is fastened to the front of the second ring at *A*. This link is unsatisfactory, partly from its limited elasticity, and partly from the variable nature of india rubber, which, in cold weather, is almost inelastic. It is in use in our tramcars; but it is placed under the car, and from being constantly covered with mud (from the streets) its elasticity is considerably diminished. Since 1879, however, it has been in use in the Norwegian Artillery for all 6 horse teams, and appears to give satisfaction. It has also been tried in the province of Scania, and, apparently with success, in the Vend Regiment of (Swedish) Artillery. In 1875–77 it was experimented upon by the Danes, but the result was not satisfactory. The dynamometer used could only be employed at the "Walk"; and the experiments consequently only took place at that pace. They showed with this defective dynamometer that the "horse-protector" of Fehrmann was of little or no use:—a result which cannot be received, being not only contrary to theory, but to the experiments of Professor Marey and Herr Sidén. The failure of these experiments was no doubt due to the use of a defective dynamometer. Fehrmann afterwards changed the india rubber rings for a spiral steel spring, and this was in use in the German Artillery in 1870. Professor Marey had one in use shortly afterwards in Paris; but the public took little interest in it, and the matter dropped.

Fig. 5 shows the "horse-protector" of the cast-steel manufactory of Döhlen, near Dresden, the elasticity of which depends on a "buffer-spring," and internally a spiral spring. It is light and cheap, but is not a trustworthy link for heavy loads.

Fig. 6 shows the J. X. L. (American) Spring Tug Links. The exterior is not prepossessing, the springs too stiff, and the elasticity too small. These links were the type used for the older Swedish "horse-protectors."

Fig. 7 shows the old Swedish links, which were similar to, and little better than the American ones.

Figs. 8 and 9 show the new Swedish links, made by Sidén. They consist of two steel spiral springs, one inside the other, which are acted upon simultaneously by the least exertion of traction by the horse. There is further a third, internal spiral spring, called by Sidén the "*stötfjäder*," or "concussion spring," which is only acted upon by pulls which are beyond the power of resistance of the other two springs:—such as in moving off, or in changing pace. There are two patterns, both of which are shown. In both of them the end pointed out by Professors Marey and Lovén is, more or less, reached. They recommended a series of three or more spiral springs, of different

strength, one in front of the other, in a tube; so that the slightest pressure should act on the first, a stronger pull on the second, &c., &c. One should not expect perfectly satisfactory results in experiments with the links, until one has had some little experience in the mode of using them.

Sidén's (horse-protector) "spring-link" for carriages with moveable shafts, or carts with fixed shafts (Fig. 10). For the application of the link (*A*) are required, besides the usual parts, the following:—

For moveable shafts: the hooks (*B*), rivetted to the shaft, and the plating (*C*), the latter without the eye (*D*). For cart shaft, supposed to be immoveable: besides the just-mentioned parts, the eyes (*D*) on the plating (*C*), and the leather straps (*E*), and the double square links (*F*) at the ends of the yoke (*G*). By this the shaft is carried. The usual slot (*H*) for the sliding link (*I*) must be of the same length as the spring link (*A*) when it is fully stretched, *less* about two centimetres: it is preferred to make this slot (*H*) slanting upward to the inside of the shaft, as by this the sliding link (*I*) will get its (fixing point) joint on the ring (*K*) nearer to the spring link (*A*). The hook (*B*) is to be fixed as far back as required to make the sliding link (*I*) bear against the rear of the slot (*H*).

The following are from among the testimonials given at end of Lieut. Frumerie's Lecture:—

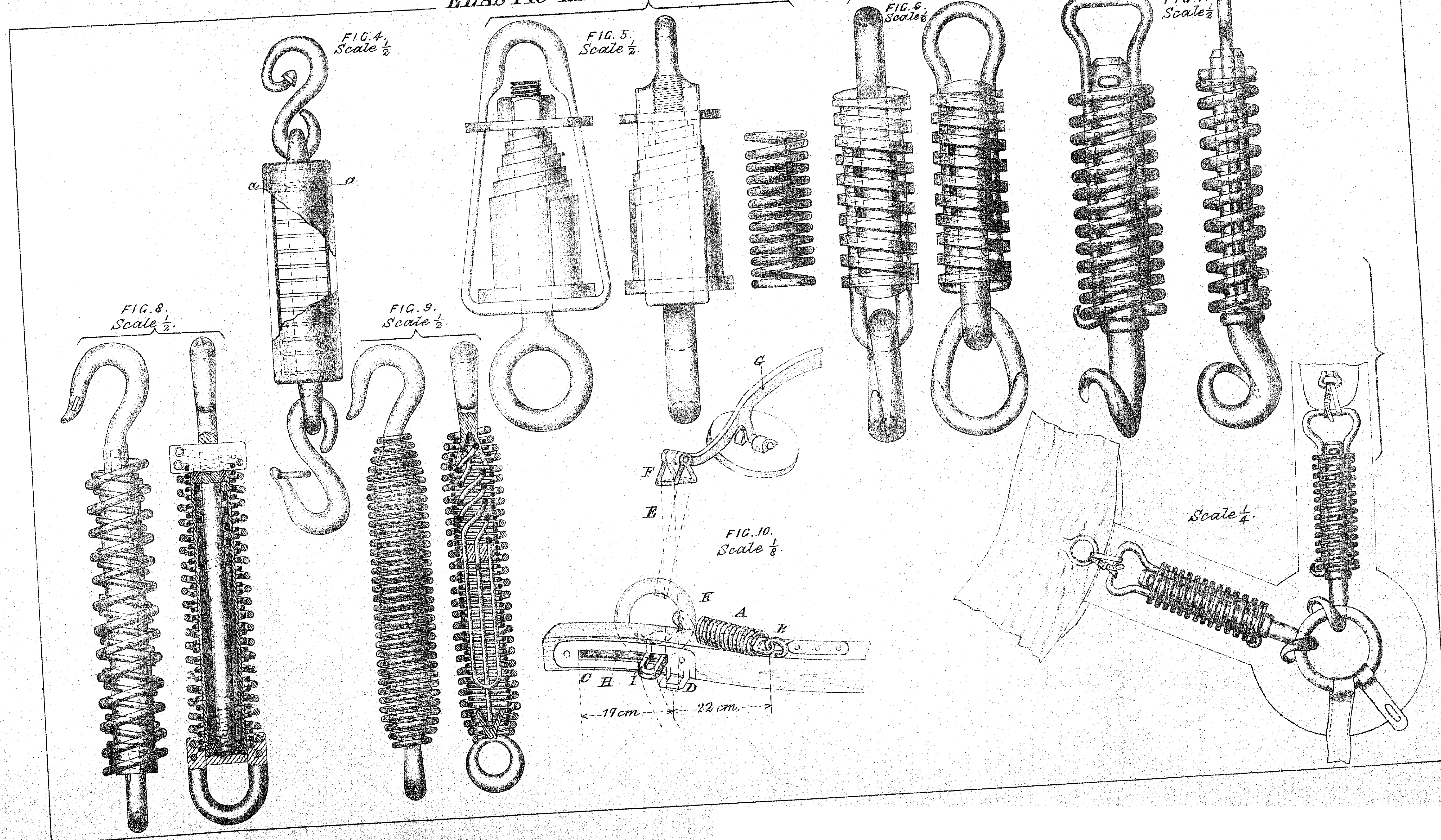
Herr Christian Lovén, Professor of Physiology in the Carlovingian Institution, Stockholm, considers the links are based on sound principles and possess very considerable elasticity.

An official report sent in by the Svea Regiment of Artillery, states that the links entirely fulfilled their object in so far as saving the horse was concerned, but in respect to durability left much to be desired. They were not used during the first day's march, because the springs had got stuck, and had to be removed. They could not be repaired on the line of march. Similar faults afterwards showed themselves in a number of the links. Owing to a collision with a gate-post, one of the links were broken, and had to be laid aside. Sand and pebbles made their way between the springs and the body of the link, which is believed to have been unfavourable to the action of the springs.

An official report from the Chief of the Under-officers School of the Svea Regiment states that the links were used during the year 1883 both on the march and at drill. The jerks and pulls to which horses are subject were very much diminished, but much was left to be desired, as regards durability. The constructor himself, Herr Sidén, admitted the material was not good.

Such is the substance of Lieut. Frumerie's Lecture. It deals with the principle of the links first, and then with the carrying out of the principle. Few will deny the correctness of the principle: as few will be found who think the question has been finally solved in practice. But the matter is so important, whether it be looked at from a military, a financial, or a humanitarian point of view, that it ought not to be neglected in England.

ELASTIC LINKS &c FOR DRAUGHT HARNESS.



NOTES:

BY VARIOUS HANDS.

In reply to the information asked for in R. A. Institution "Notes" of May, 1884, it is notified that answers have been received from the following R. A. stations:—

Aden.	Bombay.	Calcutta.	Nowgong.
Alderney.	Canterbury.	Campbellpore.	Newbridge.
Alexandria.	Colombo.	Darjeeling.	Portobello.
Allahabad.	Cork.	Gibraltar.	Quetta.
Athlone.	Chatham.	Jamaica.	Singapore.
Bellary.	Curragh.	Kurrachee.	Trincomalee

It is hoped that officers quartered at other stations will be kind enough to furnish replies, in order that when the information is published it may be as complete as possible.

In case the May Number may not be available for reference, copies of the Questions are again enclosed.

A demand having arisen for Major Pratt's "Précis of Franco-German War," which is now out of print, the Institution would gladly purchase copies from Members having no further use for them.

The Institution would also be glad to obtain, on similar conditions, copies of Nos. 1 and 5, Vol. XII., of the R. A. Institution "Proceedings."

Cricket, 1884.

(For previous Matches, see "Notes" issued with Nos. 1 and 3, Vol. XIII.)

ROYAL ARTILLERY v. ROYAL ENGINEERS.

Chatham, 11th and 12th July.

Royal Artillery.

1st Innings.		*2nd Innings.*	
Lieut. J. P. DuCane, b Fellowes	4	c and b Fellowes	7
" T. L. Coxhead, b Fellowes	11	c Renny-Tailyour, b Dumbleton...	7
" F. E. Allsopp, l b w, b Young	8	c Renny-Tailyour, b Fellowes ...	20
Capt. Bannatine, b Fellowes	0	l b w, b Young	12
" Addison, b Young	0	c and b Fellowes	1
Lieut. C. D. King, b Walton	44	c Walton, b Dumbleton	11
Capt. Hardy, c Rawson, b Young	22	b Young	30
Lieut. F. A. Curteis, c Rawson, b Young	8	c Walton, b Fellowes	3
" F. H. Crampton, run out	35	st Bonham-Carter, b Dumbleton	6
Capt. Davidson, st. Rawson, b Young...	6	c Dumbleton, b Fellowes	1
Lieut. L. W. Milles	2	not out	5
Byes 16, leg byes 4, wide 1	21	Byes 6, leg byes 1, wide 2, no ball 2	11
Total	161	Total	114

Royal Engineers.

1st Innings.		*2nd Innings.*	
H. Bonham-Carter, c Milles, b Allsopp	2	b Allsopp	11
J. E. Hamilton, b Crampton...	10		
Capt. H. W. Renny-Tailyour, b Crampton... ...	9	not out	39
W. F. H. Stafford, b Crampton	0	not out	10
H. N. Dumbleton, c and b Allsopp	1	b Curteis	19
Capt. P. G. Von Donop, b Crampton	67		
Major J. Fellowes, run out	10		
H. E. Rawson, c Davidson, b Milles	8		
Capt. Young, not out	46		
E. W. Walton, c Milles, b Allsopp	24		
W. J. Bythell, c King, b Allsopp	0		
Byes 10, leg byes 7	17	Byes 2, leg byes 1	3
Total	194	Total	82

ROYAL ARTILLERY *v.* QUID NUNC C.C.

WOOLWICH, 14TH AND 15TH JULY.

QUID NUNC.

	1st Innings.		2nd Innings.	
Lord Anson, b Lloyd		44	retired	26
H. W. Bainbridge, b Lloyd		26	run out	46
C. Wilson, b Lloyd		0	c Allsopp, b Coxhead	31
F. Marchant, run out		30	c King, b Coxhead	3
E. M. Lucas, b Lloyd		13	not out	24
P. Crutchley, run out		7	c Bannatine, b Coxhead	30
H. E. Rhodes, b Allsopp		0	c Allsopp, b Coxhead	32
J. Dale, st Davidson, b Allsopp		1	st Bannatine, b Lloyd	7
Lord Wenlock, not out		5	b Lloyd	2
S. Schultz, absent		0	b Coxhead	63
S. M. Richards, absent		0	st Bannatine, b Davidson	13
Byes 4, wide 2		6	Byes 9, wide 2	11
	Total	132	Total	288

ROYAL ARTILLERY.

	1st Innings.		2nd Innings.	
Major Beaver, c sub., b Lucas		3	did not bat.	
Capt. Stephenson, b Bainbridge		13	c Wenlock, b Bainbridge	7
Lieut. F. E. Allsopp, c Wenloch, b Bainbridge		8	c Marchant, b Richards	82
" W. N. Lloyd, b Lucas		27	not out	52
Capt. Bannatine, c Dale, b Bainbridge		4	l b w Richards	18
Lieut. C. D. King, b Bainbridge		5	did not bat.	
Capt. Hardy, c and b Bainbridge		7	did not bat.	
Lieut. T. L. Coxhead, b Lucas		4	did not bat.	
" C. R. Buckle, b Bainbridge		10	did not bat.	
" E. Phipps-Hornby, c Wenlock, b Lucas		9	did not bat.	
Capt. Davidson, not out		6	c Bainbridge, b Richards	0
Byes 12, leg byes 6, wide 3		21	Byes 16, leg byes 2, wide 7	25
	Total	117	Total	[illegible]

ROYAL ARTILLERY *v.* SEVENOAKS VINE C.C.

WOOLWICH, 18TH AND 19TH JULY.

SEVENOAKS VINE.

	1st Innings.		2nd Innings.	
A. C. Lucas	c Coxhead, b King	3	b King	30
S. J. Wilson	c Buckle, b King	1	st Allsopp, b O'Neill	42
F. Maude	c Lloyd, b King	13	c sub., b Coxhead	5
W. J. Maitland	b King	8	c King, b Coxhead	0
Capt. H. Rose, R.N.	c Allsopp, b Coxhead ...	25	c Coxhead, b O'Neill	15
Hon. J. Maxwell Scott	b King	1	not out	10
Capt. Lyle	b Coxhead	2	c Allsopp, b Lloyd	2
Draper	c Rodwell, b King	0	run out	7
Williams	c Allsopp, b Coxhead	8	absent	0
Hon. H. Hardinge	not out	9	b King	2
			Byes 4, wide 1	5
	Total	70	Total	118

ROYAL ARTILLERY.

1st Innings.

Major Anstruther	c Rose, b Draper	14
Lieut. T. L. Coxhead	b Draper	10
" F. E. Allsopp	c Maitland, b Rose	60
" W. N. Lloyd	b Rose	103
Capt. Duthy	c Williams, b Rose	11
Lieut. C. D. King	b Maude	24
" C. R. Buckle	c sub., b Rose	26
" W. H. O'Neill	b Draper	9
" E. J. Phipps-Hornby	st Draper, b Rose...	2
" A. S. Wedderburn	c Lucas, b Lyle	24
" R. M. Rodwell	not out	21
	Byes 16, leg byes 5, wide 7	28
	Total	332

ROYAL ARTILLERY *v.* ROYAL ENGINEERS.

WOOLWICH 25TH AND 26TH JULY.

ROYAL ARTILLERY.

1st Innings.		*2nd Innings.*	
Capt. Coker, b Fellowes	15	run out...	1
Lieut. J. P. DuCane, c and b Fellowes	18	b Walton	36
" F. E. Allsopp, b Dumbleton	3	l b w Young	3
" W. N. Lloyd, c Fellowes, b Dumbleton ...	15	c Bonham-Carter, b Young ...	0
" F. A. Curteis, c Van Straubenzee, b Dumbleton	26	b Walton	10
Capt. Bannatine, b Fellowes	4	b Walton	21
Lieut. C. D. King, b Walton	69	b Walton	10
Capt Hardy, hit wicket, b Dumbleton...	0	b Fellowes	9
" Addison, run out	3	b Walton	6
" Wheble, c Stafford, b Walton	44	b Walton	32
Lieut. T. L. Coxhead, not out	0	not out	9
Byes 8, leg byes 3, wide 1	12	Byes 3, leg byes 1, wide 2	6
Total	209	Total	143

ROYAL ENGINEERS.

1st Innings.		*2nd Innings.*	
H. N. Dumbleton, run out	60	not out	74
J. E. Hamilton, c Addison, b King	7		
Capt. H. W. Renny-Tailyour, c Allsopp, b Coxhead	50	b Curteis	10
L. B. Friend, c Wheble, b King	7	b Curteis	45
W. T. H. Stafford, c and b Coxhead	6	c and b Allsopp	3
Capt. P. G. Von Donop, not out	31	not out	25
" C. L. Young, c Curteis, b Coxhead	4		
Major Fellowes, c Wheble, b Coxhead...	4	c Bannatine, b Curteis	3
E. W. Walton, b Curteis	0		
H. Bonham-Carter, run out	0		
A. H. Van Straubenzee, b Coxhead	5		
Byes 1, leg byes 9, wide 2	12	Byes 6, leg byes 1, wide 1	8
Total	186	Total	[illegible]

ROYAL ARTILLERY *v.* I ZINGARI.

WOOLWICH, 4TH AND 5TH AUGUST.

I ZINGARI.

1st Innings.		2nd Innings.	
R. A. Mitchell, b Allsopp	31	c Davidson, b Bannatine	9
C. C. Clarke, st Davidson, b Bannatine	0	c Bannatine, b Marshall	51
C. E. Cottrell, b Belfield	24	c Beaver, b Marshall	140
J. E. K. Studd, b Bannatine	37	b Bannatine	17
A. J. Webbe, hit wicket, b Bannatine	44	b Allsopp	5
Lord Granville Gordon, c Bannatine, b Allsopp	35	c Allsopp, b Anstruther	1
Capt. Spens, not out	1	not out	82
S. Gore, b Allsopp	0	b Allsopp	44
G. Streatfield, b Allsopp	0	c O'Neill, b Allsopp	12
Capt. Denison, c Marshall, b Bannatine	1	st Bannatine, b Allsopp	34
F. Campbell, absent	0	b Anstruther	2
		Byes 19, leg byes 6	25
Total	173	Total	422

ROYAL ARTILLERY.

1st Innings.		2nd Innings.	
Major Anstruther, b Webbe	0	c Clarke, b Cottrell	2
Lieut. J. P. DuCane, b Cottrell	51	c Mitchell, b Webbe	4
Capt. Duthy, c Clarke, b Cottrell	4	c and b Webbe	0
Lieut. F. E. Allsopp, not out	65	c Mitchell, b Webbe	27
Capt. Griffiths, b Cottrell	5	c Mitchell, b Webbe	10
" Bannatine, c Cottrell, b Webbe	9	c Studd, b Webbe	8
Major Beaver, b Cottrell	0	c Webbe, b Cottrell	7
Capt. Davidson, b Cottrell	1	absent	0
Major Marshall, c and b Webbe	3	not out	0
Lieut. W. H. O'Neill, run out	0	c Mitchell, b Webbe	5
Lieut. S. Belfield, run out	0	b Webbe	2
Leg byes	8	Leg byes	1
Total	146	Total	66

OFFICERS *v.* N.-C. OFFICERS, ROYAL ARTILLERY.

WOOLWICH, 9TH AUGUST.

N.-C. OFFICERS.

1st Innings.		2nd Innings.	
Sergt. Golesworthy, b Buckle	1	c Belfield, b Allsopp	15
Schoolmaster Edmonds, st Allsopp, b O'Neill ...	10	l b w, b Allsopp	0
Qr.-Mr. Sergt. Hall, b Marshall	14	run out	36
Corporal Duke, b Buckle	0	c Marshall, b Allsopp	7
Sergt. Hunter, c O'Neill, b Belfield	40	c de Robeck, b Allsopp	24
Schoolmaster Gooding, c and b de Robeck	2	not out	13
Corporal Williams, c Buckle, b Belfield	32	b Allsopp	25
Qr.-Mr. Sergt. Polson, run out	22	c Marshall, b Heyman	20
" Bilton, run out	13	b Allsopp	5
Sergt. Wright, not out	1	b Allsopp	2
Bombr. McCaulis, b O'Neill	0	not out	10
Qr.-Mr. Sergt. March, c Marshall, b O'Neill ...	0	did not bat.	
Byes 7, leg byes 2, wide 3	12	Byes 5, wide 1	6
Total	147	Total	163

OFFICERS.

1st Innings.

Capt. C. H. Hamilton, l b w, b Golesworthy	3
Lieut. C. R. Buckle, c Edmonds, b Golesworthy	29
" F. E. Allsopp, c Hunter, b Duke	14
" H. de Robeck, l b w, b Golesworthy	2
" W. H. O'Neill, b Duke	16
" R. M. Rodwell, b Golesworthy	5
Major Marshall, c Polson, b Golesworthy	17
Lieut. C. E. Heyman, c Bilton, b Golesworthy	7
Lieut.-Col. Lynes, b Duke	0
Major Cowan, b Golesworthy	8
Lieut. S. Belfield, not out	5
Byes	12
Total	118

RESULT OF MATCHES, 1884.

Matches played 14. Won 3. Lost 8. Drawn 3.

Opponents.	Where played.	When played.	R. A.		Opponents.		Remarks.
			1st Innings.	2nd Innings.	1st Innings.	2nd Innings.	
Won.							**Won by**
N.-C. Officers, R.A. ...	Woolwich	May 10	152	11	99	63	10 wickets; N.-C. O.'s played 12 men.
R.M. Academy	"	June 6, 7	141	179	127	71	122 runs.
Sevenoaks Vine.........	"	July 18, 19	332	—	70	118	Innings and 144 runs.
Drawn.							
B. B.	Woolwich	June 13, 14	209	—	214	309	B. B. lost 9 wickets.
Household Brigade ...	"	" 26, 27	234	223	308	—	R.A. " 7 "
Quid Nunc...............	"	July 14, 15	117	184	132	288	R.A. " 4 "
Lost.							**Lost by**
Free Foresters	Woolwich	June 2, 3	182	235	178	240	5 wickets.
Aldershot Division ...	Aldershot	" 16, 17	124	189	258	57	8 "
Yorkshire Gentlemen	Woolwich	" 20, 21	160	103	272	—	Innings and 9 runs.
Harlequins...............	"	July 9, 10	90	94	314	—	" 130 "
Royal Engineers	Chatham	" 11, 12	161	114	194	82	8 wickets.
Royal Engineers	Woolwich	" 25, 26	209	143	186	168	6 "
I Zingari	"	Aug. 4, 5	146	66	173	422	383 runs.
N.-C. Officers, R.A. ...	"	" 9	118	—	147	163	29 runs on 1st innings; N.-C.O.'s played 12.

BATTING AVERAGES.

Officers.	No of Innings.	Times not out.	Runs.	Most in a Match.	Average.	Remarks.
Lieutenant F. E. Allsopp	22	1	663	146	31·12	
" C. D. King	18	—	411	79	22·15	
" C. R. Buckle..............	10	4	126	49	21	
" J. P. DuCane	15	—	279	56	18·9	
Captain Stephenson	11	1	176	54	17·6	
" Bannatine	21	—	324	100	15·9	
" Hardy	13	1	152	52	12·8	
" Davidson	17	1	200	126	12·8	
Lieutenant E. Phipps-Hornby	8	2	75	26	12·3	
" H. de Robeck	7	1	72	35	12	
" T. L. Coxhead	8	2	71	30	11·5	

No. 5. Vol. XIII.

RULE XIX.

"The Institution will bear a share (not exceeding two-thirds) of the expense of a class at any out-station at which as many as three of its Members will combine for the purpose.

"The class to designate one of their number who will engage to furnish a return of the Members present at each attendance of the Master, and to manage the payments. An account to be sent quarterly to the Secretary of the Institution."

The Committee is further authorized to assist, at its discretion, from the Funds of the Institution, any Member desirous of professional instruction.

LIST OF BOOKS, &c.,

most of which can be procured at the Royal Artillery Institution by Members.

[THE PRICES QUOTED BELOW ARE EXCLUSIVE OF POSTAGE.]

Lists, Rosters, &c.

KANE'S LIST. Revised Edition. List of Officers of the Royal Regiment of Artillery, from the year 1716 to the present date. Price 2s. 6d. Under 3 lbs.

ALPHABETICAL LIST OF THE OFFICERS OF THE ROYAL REGIMENT OF ARTILLERY. Published quarterly. Price 6d., or by Annual Subscription, giving four copies, 1s. Under 2 ozs.

REGIMENTAL LIST. Showing Distribution by Districts, and containing Roster of Batteries for Foreign Service and Relief. Under 2 ozs. Published occasionally. Can be obtained gratis upon application.

LIST OF SERVICE ORDNANCE AND AMMUNITION. Published occasionally. A copy is sent to each Member, gratis, with the first number of the "Proceedings" issued after its publication. Further copies can be obtained by Members at the rate of 2d. each. Under 4 ozs.

OFFICIAL CATALOGUE OF THE MUSEUM OF ARTILLERY IN THE ROTUNDA, WOOLWICH. Price 1s. 6d. Under 12 ozs.

LIST OF CHANGES IN WAR MATÉRIEL. Published by the War Office. Gratis. Under 2 ozs.

Proceedings, R.A.I., and D. of A., &c.

MINUTES OF PROCEEDINGS OF THE R.A. INSTITUTION. Vols. III., IV., V., VI., VII., VIII., IX., X., and XI. Vols. I. and II. are out of print. Members can obtain single numbers of the "Proceedings," the prices of which vary according to contents.

EXTRACTS FROM THE REPORTS AND PROCEEDINGS OF THE DEPARTMENT OF THE DIRECTOR OF ARTILLERY AND STORES. Published quarterly.

Handbooks, &c.

HANDBOOK FOR FIELD SERVICE. Vol. I. Field Artillery. Price, to Members and N.-C. Officers (through their Commanding Officers), 2s. 6d. Under 12 ozs.

THE ARTILLERIST'S MANUAL, AND BRITISH SOLDIER'S COMPENDIUM. Eleventh Edition. Edited by Majors L. Griffiths and F. Duncan, R.A. Price 4s. 2d. Under 8 ozs.

THE ARTILLERIST'S HANDBOOK OF REFERENCE. By Capt. Will, R.A., and Lieut. Dalton, R.H.A. Price 5s. Under 1 lb.

TEXT BOOK ON MILITARY TOPOGRAPHY. By Colonel W. H. Richards. Temporarily out of print.

GUIDE TO SIMPLE FARRIERY. By Capt. J. Hotham, R.A. Gratis. Under 2 ozs.

MILITARY DICTIONARY. Compiled by Maj.-General G. E. Voyle, *late* R.A. Price 10s. 6d. Under $1\frac{1}{4}$ lbs.

Artillery and Gunnery, &c.

THE PRINCIPLES AND PRACTICE OF MODERN ARTILLERY. By Lieut.-Col. C. H. Owen, R.A., late Professor of Artillery, Royal Military Academy, Woolwich. 2nd Edition. Price 12s. 6d. Under 3 lbs.

THE PRINCIPLES OF GUNNERY. By Major J. Sladen, R.A. Out of print.

TEXT BOOK ON GUNNERY. By Capt. G. Mackinlay, R.A. Price 3s. 6d. Under 1 lb.

FIELD ARTILLERY. ITS EQUIPMENT, ORGANIZATION AND TACTICS. By Major S. C. Pratt, R.A. Price 4s. 6d. Under 1 lb.

MANUAL OF GUNNERY FOR H.M. FLEET, 1880. Price 5s. Under 2 lbs.

THE APPLICATION OF PROFESSOR BASHFORTH'S GENERAL TABLES TO PROBLEMS IN PRACTICAL GUNNERY. By Captain J. Sladen, R.A. Price 3d. Under 2 ozs.

ON THE MOTION OF A PROJECTILE IN A RESISTING MEDIUM. By Professor A. G. Greenhill, M.A. Price 6d. Under 4 oz.

USEFUL TABLES. By Major W. H. Noble, R.A. 2nd Edition. Price 1s. 2d. Under 4 ozs.

Drill Books, &c.

MANUAL OF SIEGE AND GARRISON ARTILLERY EXERCISES. Vols. I. and II. Price 2s. 6d. Under 1¼ lb.

INSTRUCTIONS FOR THE SERVICE OF SIEGE ARTILLERY, 1880. Price 3s. 2d. Under 1 lb.

HEAVY GUN DRILL. Compiled by Major W. O. Carlile, R.A. Gratis. Under 4 ozs.

MANUAL OF FIELD ARTILLERY EXERCISES. Interleaved. Price 2s. 8d. Under 3 lbs.

FIELD EXERCISES AND EVOLUTIONS OF INFANTRY. Temporarily out of print.

REGULATIONS FOR THE INSTRUCTION AND MOVEMENTS OF CAVALRY. Temporarily out of print.

REGULATIONS AND INSTRUCTIONS FOR ENCAMPMENT. Price 5d. Under 4 ozs.

MANUAL OF ELEMENTARY FIELD ENGINEERING, 1883. Price 1s. 2d. Under 6 ozs.

Manufacture of Matériel, &c.

TREATISE ON THE CONSTRUCTION OF ORDNANCE, 1879. Temporarily out of print.

TREATISE ON AMMUNITION, 1881. Temporarily out of print.

NOTES ON AMMUNITION, 1881. Price 1s. 9d. Under 1 lb.

HANDBOOK OF ARTILLERY MATERIEL. By Captain F. C. Morgan, R.A. Price 4s. 3d. Under 8 ozs.

TREATISE ON MILITARY CARRIAGES, and other Manufactures of the Royal Carriage Department, 1879. Temporarily out of print.

HANDBOOK FOR MILITARY ARTIFICERS. Price 2s. 3d.

Interior Economy, &c.

MANUAL OF INTERIOR ECONOMY. By Major O. H. Goodenough, R.A. Price 4s. Under 1 lb. 2 ozs.

OFFICE MANUAL, 1882, FOR HORSE, FIELD, AND GARRISON BATTERIES OF ROYAL ARTILLERY. Edited by Lieut.-Col. R. W. Phipps, R.A. Price 2s. Under 12 ozs.

Military Law and Regulations, &c.

ARMY ACT ALPHABET. By Capt. Will, R.A. Price 1s. 8d. Under 4 ozs.

W.O. MANUAL OF MILITARY LAW, 1884. Price 1s. 9d. Under 2 lbs.

MILITARY LAW: its Procedure and Practice. By Major S. C. Pratt, R.A. Price 3s. 6d. Under 12 ozs.

MILITARY ADMINISTRATION AND MILITARY LAW. By Lt.-Colonel J. Boughey. 8th Edition. 1883. Price 5s. Under 1 lb.

HINTS ON COURTS-MARTIAL. By J. C. O'Dowd. Price 3s. 6d. Under 8 ozs.

ANALYSIS OF CRIMES AND PUNISHMENTS; Army Act of 1881. By Capt. S. C. Pratt, R.A. Gratis.

QUEEN'S REGULATIONS, 1881. Interleaved. Price 2s. 8d. Under 3 lbs.

ROYAL WARRANT; PAY, PROMOTION, &c., 1884. Price 2s. 8d. Under 12 ozs.

DRESS REGULATIONS FOR THE ARMY. 1883. Price 1s. 6d. Under 14 ozs.

Regimental and Military History, &c.

HISTORY OF THE ROYAL ARTILLERY. By Major F. Duncan, R.A. 2 Vols. Price 13s. 6d. Under 5 lbs.

THE ENGLISH IN SPAIN; OR THE STORY OF THE WAR OF SUCCESSION IN 1834–40. By Major F. Duncan, R.A. Price 12s. Under 2¼ lbs.

CORUNA TO SEVASTOPOL: The History of "C" Battery, "A" Brigade (*late* "C" Troop), R.H.A. By Colonel F. A. Whinyates, *late* R.H.A. Price 11s. 8d. Under 2 lbs.

RECORDS OF THE HORSE BRIGADE. By Col. J. E. Michell, C.B., R.H.A. Price 8s. 9d. Under 1½ lb.

HISTORY OF THE BENGAL ARTILLERY. By Lieut.-Col. F. W. Stubbs, R.A. 2 vols. Price £1 13s. 6d. Under 2 lbs. and 1½ lb. respectively.

FRANCO-GERMAN WAR, PRÉCIS OF. By Captain Pratt, R.A. Price 4s. 6d. Under 1 lb.

SHORT NOTES ON TACTICS AND RECONNAISSANCE. By Captain J. R. J. Jocelyn, R.A. Gratis to Members of the R.A. Institution.

MILITARY MAPS AND BOOKS, published "by authority," can be obtained by officers *direct* from the Topographical Department, War Office, **post free**, a District Paymaster's receipt being forwarded with the demand. (*Vide* Clause 15 of Army Circulars, dated 1st January, 1883.)

PRÉCIS OF
EXPERIMENTS AT DUNGENESS AND LYDD,
1880-81-82-83.

BY

LIEUT.-COLONEL F. G. BAYLAY, R.A.

DURING the last four years (1880 to 1883 inclusive) a large number of important experiments have been carried out at Dungeness and Lydd, by the Siege Operations and Ordnance Committees, with the view of acquiring information regarding the different natures of Artillery Fire likely to be employed in a siege, and the relative power and suitability of the guns and howitzers of the Siege Train, when used under the various conditions likely to be met with on service.

Although full and detailed reports of these experiments have been issued annually, they have only been supplied to a few Heads of Departments, and to the Officers composing the Committees charged with carrying out the experiments: therefore but few Officers have had the opportunity of making themselves conversant with the subject.

The following précis has been drawn up with the view of supplying the want indicated, and of giving, in a concentrated form, all necessary information regarding the results obtained and the conclusions drawn therefrom.

Experiments carried out at Dungeness in 1880, under the Siege Operations Committee.

Of the numerous experiments carried out by the Siege Operations Committee, reference will only be made in these papers to those in connection with breaching, not only for the sake of economising space, but also because the other experiments (such as those carried out with small arms, wall pieces, and machine guns, &c.), though interesting in themselves, are less likely to prove of value to the Artilleryman than those which bear more especially on the Artillery operations of a siege. **Introductory remarks.**

PRELIMINARY TRIALS.

Before entering upon the main breaching experiments, the Committee carried out a series of preliminary trials with the view of gaining information on the following points, viz. :— **Preliminary trials.**

1. The lowest limit of effective striking velocity of shells of various descriptions, on concrete and brickwork.

on direct impact, but cannot be depended on to act on graze when fired at angles of elevation under 10°. It is the percussion fuze almost exclusively used for common shell in the siege train at the present time.

Relative effects of Gunpowder and Guncotton Bursters.

It cannot be said that the relative efficacy of these two explosives when employed as shell bursters has as yet been determined.

In the experiments under consideration only common cast-iron shell were provided, consequently the wet guncotton discs had to be granulated and pressed by hand into the shell with a wooden drift. The result was that a charge of only from one-half to one-third the weight of the powder burster could be got into the shell, and what guncotton was inserted was too full of air spaces to enable it to be properly detonated. The further disadvantage arose that the range was affected by the lightness of the shells so filled.

Still, notwithstanding these drawbacks in the only instance where a direct comparison could be instituted, the guncotton manifestly produced the best effect.

The subject of shell bursters is now engaging special attention, and it is probable that considerable light will ere long be thrown on this important question.

Main Breaching Experiments.

In future sieges the Artillery of the attack will often be called upon to form breaches, under conditions of considerable difficulty, consequent upon the more general adoption of a system of narrow deep ditches with low well covered escarps and detached walls. In many cases it may be necessary to secure angles of descent for the projectiles up to 20°, or even more; and the experiments now under consideration were carried out to ascertain whether high angles of descent could be secured from our rifled howitzers, at long ranges, in conjunction with a reasonable amount of accuracy and striking velocity.

It is evident that in long range curved fire the only method of destroying a concealed wall is by means of fire generally distributed over the portion intended to be breached: this system has the advantage of causing the masonry to be well broken up, and hence it combines with the earth of the parapet to form a practicable slope.

First experiment. In the first experiment, fire was opened at a range of 1600 yards, from two sunken batteries, armed respectively with 8-inch R.M.L. howitzers of 70 cwt., and 6·6-inch howitzers of 36 cwt. (2 howitzers in each battery). The fire was directed against the counter-arched portion of the main revetment with the object of forming two practicable breaches, each battery acting quite independently of the other.

It was so arranged that each breach should be made half in concrete and half in brickwork, so as to obtain an insight into the comparative value of these two materials for resisting shell fire.

The height of the wall was 18 feet, and its thickness at the cordon 4 feet $1\frac{1}{2}$ inches. At the lowest calculated point of impact (10 feet below the cordon) the thickness was as follows, viz., concrete 3 feet 9 inches, brickwork 3 feet.

The crown of the counter-arches was 4 feet 6 inches below the cordon.

The crest of the glacis was 4 feet above the top of the wall.

The conditions of fire, which was oblique in both cases, were as follows, viz.:—

8-inch howitzers.

Horizontal angle of line of fire with face of wall 54° 30′.
Projectile,—Common shell 180 lb., with direct-action fuze.
Bursting charge, 14 lbs. (nearly)
Angle of descent, 14° 18′.
Striking velocity, 579 f.s.

6·6-inch howitzers.

Horizontal angle of line of fire with face of wall 60°.
Projectile,—Common shell, 100 lbs., direct-action fuze.
Bursting charge, 5 lbs. 8 oz.
Angle of descent, 14° 12′.
Striking velocity, 547 f.s.

The firing was carried out in this, and in the subsequent experiments, under service conditions, *i.e.*, the officers directing the fire had to rely on their own observations for applying corrections. It is true that they had an observing party, with which they were in telephonic communication, in a splinter proof 200 yards short of the glacis, but this point was situated so low down, that it was soon found that their observations were less trustworthy than those taken from the batteries.

It is worthy of note that the weather was clear, fine, and nearly calm. Subsequent experiments have proved that, in squally weather, the efficiency of howitzer fire, especially at high angles, is very largely impaired.

After 112 rounds had been fired from the 8-inch howitzers a practicable breach, 36 feet wide at the neck, was formed. 35 per cent. of the shells fired had taken effect on the wall. The distribution of the rounds was as follows:—

On wall	39
" parapet	33
" glacis...	29
Under	6
Over	5
Total	112

It took 300 rounds from the 6·6-inch howitzer to form a practicable breach 30 feet wide at the neck, and only 24 per cent. of the shells

fired took effect on the wall. The distribution of rounds was as follows :—

On wall	72
„ parapet	99
„ glacis...	103
Under	8
Over	18
Total	300

Rate of firing.

The rate at which it was found practicable to maintain an accurate fire was one round every three minutes from each howitzer (whether 8-inch or 6·6-inch), or twenty rounds an hour per piece.

From this experiment it will be seen that the heavier piece does the work required in from a half to a third the time required by the lighter, and not only so, but the actual total weight of material required to be moved up from the base of operations is *greater* for the latter than for the former[1].

Accuracy and shell power being the chief essentials for work of this nature, the importance of employing, whenever practicable, pieces in which these qualities are combined is obvious.

It is to be observed that, from the fact of the parapet being made of shingle, which flowed down very freely as soon as the upper part of the wall was destroyed, the breach became practicable at an earlier period than would have been the case had the parapet been formed of earth—indeed the shingle ran down and formed an unbroken slope before the arch-rings were destroyed.

Second experiment.

In the second experiment two breaches were formed in the plain portion of the revetment, by the oblique curved fire of the 6·6-inch and 8-inch (70 cwt.) howitzers at ranges of 2300 and 2500 yards respectively. The conditions of fire were as follows :—

6·6-inch howitzers.

Horizontal angle of line of fire with face of wall 54° 30′.
Projectile,—common shell, 100 lbs., with direct-action fuze.[2]
Bursting charge, 5 lb. 8 oz.
Angle of descent, 14° 8′.
Striking velocity, 666 f.s.

8-inch howitzers.

Horizontal angle of line of fire with face of wall, 48°.
Projectile,—common shell, 180 lb., with direct-action fuze.[3]
Bursting charge, 14 lb.
Angle of descent, 12° 12′.
Striking velocity, 742 f.s.

---

[1] 55 cwt. more material was required for the lighter howitzer than for the heavier.
[2] A few battering shell were also fired. [3] *Ibid.*

The crest of the glacis was as in the first experiment, 4 feet above the cordon.

The thickness of the wall was 6 feet 6 inches at top, and about 7 feet 6 inches at half way down. Each breach was formed half in brickwork and half in concrete.

The result of the firing was as follows :—

After 139 rounds from the 8-inch howitzers (of which 33 per cent. took effect on the wall) had been fired, a practicable breach, about 30 feet wide at the neck, was formed. **8-inch howitzers.**

The distribution of the rounds was,—

On wall	46
" parapet	42
" glacis...	44
Under	2
Over	5
Total	139

After 175 rounds had been fired from the 6·6-inch howitzers the practice was discontinued owing to there being no more common shell. The breach was only about half formed, and it was calculated that as much ammunition again would have to be expended to make it practicable. **6·6-inch howitzers.**

The practice of the 6·6-inch howitzer at this long range (2300 yards) is far from accurate : only 15 per cent. of the shells fired taking effect on the wall, although the atmospheric conditions were fairly favorable.

The third experiment was breaching the detached wall with the 6·3-inch howitzer by oblique fire at 1000 yards. **Third experiment.**

In this case the crest of the glacis was 2 feet 8 inches above the top of the wall, which was 13 feet 6 inches high. It was made of hard bricks set in cement, and was 2 feet 3 inches in thickness, with counterparts 2 feet 3 inches in depth, and about 7 feet 6 inches apart in the clear.

The conditions of fire were as follows :—

6·3-inch howitzers.

Horizontal angle of line of fire with face of wall 60°.
Projectile,—common shell, 70 lb., with direct-action fuze.
Bursting charge, 7 lb. 2 oz.
Angle of descent, 20°.
Striking velocity, 370 f.s.

When 123 rounds had been fired, of which 28 per cent. hit the wall, a gap was found to have been made in the wall low down, 6 feet wide and 2 feet 9 inches high, besides which the wall was very considerably injured and shaken. With the small charge ($1\frac{1}{2}$ lb.) used, the shells were unsteady in flight, and consequently the fire was somewhat erratic, besides which, from the fact of their being no work behind

the wall on which to note the point of impact, considerable difficulty was experienced in correctly estimating the results obtained.

It is to be observed that owing to the detached and sunken position of walls of this nature no indications are afforded to the battery of the effect of the fire; and moreover, as the demolition proceeds, many shells will be wasted by passing through gaps already formed in the masonry.

The distribution of the rounds fired were as follows:—

Under and on glacis ...	40
Hit wall	34
Through gaps and over ...	49
Total	123

Conclusions.

Maximum ranges for breaching.

From the experience gained in these experiments, it was deduced that the howitzers of the Siege Train may be successfully employed for breaching concealed revetments by curved fire up to the ranges specified below, viz.:—

6·3-inch R.M.L. howitzer	1600 yards.
6·6 " " "	2300 "
8 " " (70 cwt.) "	2800 "

Reverse laying.

The great efficacy of the "reverse" system of laying was thoroughly established in these experiments, which were the first trials of curved fire for the destruction of masonry revetments carried out in this country since the year 1822, when a trial was made with a 24-pr. S.B. gun, and 8-inch and 10-inch S.B. howitzers firing spherical projectiles with reduced charges against a dummy wall of masonry; under such conditions, the results obtained must naturally have been comparatively insignificant.

Relative value of concrete and brickwork.

The concrete was found to be so inferior to brickwork for resisting shell fire that the conclusion was arrived at that concrete should only be used for such walls or parts of walls as are not liable to be exposed to breaching fire.

Captive Balloons.

In these experiments trial was made of captive balloons with the view of ascertaining their value as a means of taking observations.

The balloons used were skilfully worked by Captain Templer and Captain Elsdale, R.E., assisted by a body of trained sappers.

The trials made showed that a captive balloon in calm weather affords a favorable post of observation: owing, however, to the many drawbacks attending their employment the Committee refrained from recommending their introduction into Siege Train equipment.

The disadvantages referred to may be stated to be as follows:—

1. The fact that they can only be used in calm weather.

2. The difficulty of obtaining gas, and filling them.

3. Extra transport required, and the difficulty of bringing them to the required point of observation.

4. The fact that (even when constructed to carry only one man) they offer so large a target for the enemy's fire that they could only be used at long distances from the object to be observed.

In order to ascertain how far captive balloons are liable to be injured by shrapnel fire, two rounds were fired from the 13-pr. R.M.L. field gun at a balloon anchored at a height of about 850 feet, and at a range ascertained by the Watkin range-finder to be 1950 yards. The size of the balloon was:—height 42 feet, greatest diameter 33 feet. The first round was estimated to burst 30 and the second 50 yards short. The result was that 56 holes (some of them large rents) were made in the balloon, which slowly sunk to the ground. It is almost needless to say that had there been anyone in the car it would have come down much faster. It was intended to have carried out a similar trial at 4000 yards, but a squall of wind blew the balloon down on the sea and burst it, so the trial never came off: having regard however to the large size of target offered by balloons, it is reasonable to infer that even at this distance they would not long remain uninjured if exposed to the shrapnel fire of accurate rifled pieces.

It would have been both interesting and instructive if opportunity had been afforded, in the late campaign in Egypt, of trying a captive balloon. Such countries (in which the atmosphere is generally still and clear) afford of course special facilities for their employment, provided gas can be procured, or manufactured on the spot.

Experiments carried out in 1881, under the Ordnance Committee, at Dungeness.

The object of these experiments was to ascertain the penetration and disruptive effect of shells fired from heavy and siege guns into concrete, earth, and sand. As the size of the targets was small, and the amount of ammunition limited, it was decided to carry out the experiments at such short ranges as would enable each shot to be planted in the desired position on the work fired at. **Object of experiments.**

Concrete Butt.

The dimensions of this butt, which was built by contract, and completed in June, 1879, were as follows:—

Length 39 feet, height 12 feet, thickness 31 feet.

The concrete was composed of 6 parts shingle, 1 part sand, 1 part Portland cement. Weight per cubic foot 138 lb.

The Dungeness butt may be considered a fair average example of concrete made of rounded shingle.

It is however worthy of remark that the material in the interior was more full of air spaces, and consequently weaker than on the outside. In the case of concrete composed of smooth water-worn stones it would seem necessary, in order to fill the interstices, to use a larger proportion of sand than is considered requisite for concrete made with broken stones. The concrete was laid and rammed in layers from 9 to 12 inches thick. The want of cohesion between the layers, which was evident from the first, may be, in a measure, referred to the fact that they were not keyed together, and were consequently more easily disturbed than would have been the case had this precaution been taken.

Ranges.

The concrete butt was fired at, from the land side, by the 10-inch R.M.L. gun of 18 tons, and the 6-inch B.L. gun of 80 cwt., at a range of 145 yards, and from the sea side by the 6·6-inch R.M.L. gun, at a range of 41 yards; the line of fire was at right angles to the face of the butt in each case.

The following tables show the charges used, striking velocity, &c., of the guns fired at the concrete butt:—

GUNS FIRED AT CONCRETE BUTT.

Ordnance.	Charge.	Weight of projectile.	Velocity f.s. Muzzle	Velocity f.s. Striking	Striking energy.	Range.
	lb.				f. t.	
10-inch R.M.L. 18 tons ...	95 P².	408	1446	1424	5738	145 yards.
6-inch B. L. 80 cwt.	34 P.	80	1944	1893	1989	Do.
6·6-inch R.M.L. 70 cwt. ...	25 P.	100	1509	1497	1555	41 yards.

BURSTING CHARGES OF SHELLS.

Nature of shell.	10-inch R.M.L.	6-inch B.L.	6·6-inch R.M.L.
Common	20 lb. 4 oz.	5 lb.	5 lb. 8 oz.
Palliser	7 lb.	1 lb. 9 oz.	2 lb. 1 oz.

MAXIMUM PENETRATIONS.

Ordnance	Palliser shell.	Common shell.
10-inch R.M.L. 18 tons	17 ft.	13 ft. 10 ins.
6-inch B. L. 80 cwt.	12 ft. 7 ins.	10 ft. 9 ins.
6·6-inch R.M.L. 70 cwt.	8 ft. 2 ins.	8 ft. 5 ins.

N.B.—The shells fired for penetration were weighted and plugged.

The following conclusions were drawn at the end of the trials for penetration into concrete:—

1. The Palliser shells generally attained to a somewhat higher penetration than the common shells.

2. The majority of the shells of all natures on entering the butt, exhibited a tendency to turn to the right, a few went in straight, and one or two turned slightly to the left. It was observed that a sharp turn has a marked effect in diminishing penetration.

Palliser shell.

3. None of the Palliser shells fired from any of the guns broke up, nor, when filled with powder, did they burst. One of the 6-inch B.L. Palliser shells penetrated 12 feet 7 inches, rebounded 8 feet, and entered the side of its tunnel.

10-inch common shell.

4. Common shell were fired from the 10-inch gun, both weighted and plugged and filled, but no fuze; in neither case did they break up or burst.

6-inch common shell.

5. The common shell fired, weighted and plugged, from the 6-inch B.L. gun did not break up: this is very remarkable, as the striking velocity was close on 1900 f.s., and what is equally curious is that this shell after penetrating 10 feet 9 inches into the butt, rebounded clean out of it. The bush and plug had been driven into the nose of the shell. The common shell that were fired from the same gun, filled but no fuze, burst in the butt from the heat generated from impact.

6·6-inch common shell.

6. Of the two common shell fired from the 6·6-inch R.M.L. gun, weighted and plugged, one broke up and one did not: an examination of the fragments of the shell that broke up led to the conclusion that it was a somewhat defective casting. The common shell fired filled, but no fuze, did not burst or break up.

It was worthy of note how the projectiles entering at high velocity made tunnels through the concrete of considerably larger section than a cross section of the shell: thus a 6-inch shell would form a tunnel about 1 foot in diameter, and completely pulverize the hard flint stones of the concrete throughout the whole of the tunnel so made. The higher the velocity the more was this effect observable. It might aptly be compared to a torpedo boat travelling at great speed carrying a lofty wave off each bow. This wide distribution of force must

naturally bring the projectiles to rest sooner than would be the case if the resistance was confined to their sectional area.

It may be interesting to here observe that in recent penetration experiments carried out at Shoeburyness with Palliser shell fired from the 80-ton gun at a range of 200 yards at concrete made of broken granite, the shell penetrated a distance of 34 feet, forming a tunnel about 2 feet 3 inches in diameter. The disturbing and destructive effect on the structure were very great. The shell weighed 1700 lb., the charge used was 450 lb. of prism powder, and the striking velocity about 1586 f.s. and the striking energy about 30,000 f.t.

Experiments at Concrete Butt with Common Shell filled and fuzed.

The following table gives the mean penetration of the shells fuzed with quick fuzes to the point of burst:—

Ordnance.	Mean penetration to point of burst.	Remarks.
10-inch R.M.L. gun ...	8 ft. 9 ins.	All fuzed with the direct-action percussion (quick) fuze.
6-inch B.L. gun	5 ft. 9 ins.	
6·6-inch R.M.L. gun ...	4 ft. 7 ins.	

It is observable that, owing to the high striking velocities, the shells, although fuzed with a quick-action fuze, attained to considerable penetration before bursting, and were thus enabled to produce large results.

The powerful shells of the 10-inch gun, filled with 20 lb. 4 oz. of powder, were enormously destructive, not only forming large craters from 10 to 14 feet in diameter, but starting and shaking the material over great distances, and throwing down the concrete in masses.

Delay-action fuzes.

Two common shells were fired from the 6·6-inch gun filled and fuzed with delay-action fuzes—one was observed to give about a half-seconds delay, with the other no delay was observed, but as they both attained to the same penetration, 7 feet 9½ inches, it is reasonable to suppose that there actually was a short delay and that both shell reached extreme penetration, especially as the plugged shell from this piece entered about the same distance.

The 6·6-inch shells with delay-action fuzes wrought less destruction than those with quick fuzes which may be accounted for by the fact of the shells only holding a small bursting charge, 5 lb. 8 oz., so that when the penetration reaches a certain point they act as an undercharged mine.

Conclusions.

From these experiments it was evident that the common shell is by far the most effective projectile to employ for the destruction of concrete—in penetration it is not much inferior to the Palliser shell if fuzed with a delay fuze, and its far larger bursting charge enables it to produce very considerably larger destructive effects, especially with the larger calibres. That quick-action fuzes are generally to be preferred

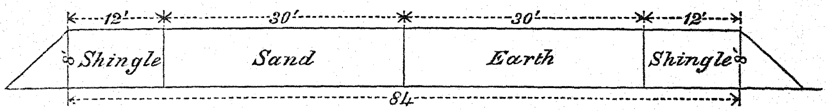
to those with delayed-action as the former are not so quick but that the shell gets fairly in, and does good work, whereas with a delay fuze the shell *may* enter so far as to be unable to move the surrounding mass of concrete. This is especially the case with shells of small or medium calibre.

There, however, seems no reason to doubt that the powerful shell of the 10-inch gun would act effectively at greater penetration than a quick fuze allows of, and would consequently, with a fuze giving small delay, secure even larger results than those exhibited in this experiment.

Experiments at Earth and Sand Butt.

The earth and sand butt was of the following dimensions, viz. :— **Penetration.**

Frontage,—84 feet, exclusive of slopes.
Depth from front to rear,—48 feet, exclusive of slopes.
Height,—8 feet.



The earth may be described as a rough loamy clay with a fair sprinkling of chalk, stones and brickbats. The sand was remarkably pure and free from stones or any extraneous matter.

The following pieces were employed in this experiment, and plugged projectiles of the nature noted were fired at a range of 195 yards.

10-inch R.M.L. gun of	18 tons.	Palliser and Common.	
6-inch R.B.L. "	80 cwt.	"	"
6·6-inch R.M.L. "	70 "	"	"
8-inch R.M.L. howitzer of	70 cwt.	Common only.	
6·6-inch " "	36 "	"	

Owing to the small height of the butt the whole of the shells fired from the 10-inch gun rose out of it, with the exception of one common shell fired at earth which was found at 34 feet 6 inches penetration; it had turned off to the right and entered the shingle portion of the butt.

The following table shows the mean penetration :—

Ordnance.	Striking velocity.	Penetration.			
		Palliser.		Common.	
		Earth.	Sand.	Earth.	Sand.
	f.s.				
10-inch gun......	1416	All rose out of butt.		34′ 6″*	All rose out of butt.
6-inch gun......	1875	All broke up.	12′ 3½″	All broke up.	All broke up.
6·6-inch gun ...	1452	14′*	Not found.	14′ 6″*	11′*
8-inch howitzer	921	None fired.		19′ 5″	13′
6·6-inch "	841	Do.		16′ 0	13′ 9″*

* One round.

Some very remarkable results were obtained in this practice, viz.:—

1. All the projectiles fired from the 6-inch B.L. gun broke up on impact, with the exception of the Palliser shell fired into sand, whereas similar projectiles fired from the same piece, under almost exactly the same conditions, as regards striking velocity, into solid concrete did not break up.

2. It was observed, wherever the means existed for comparing results, that the penetration into sand was considerably less than into earth. In the latter material the penetration would vary with the quality of the soil, and be considerably influenced by the extent to which it was saturated: whereas in sand the penetration might be expected to be more constant.

3. The displacement of material from the impact of shells striking with high velocity, and which did not break up, was also much greater in earth than in sand. In the case of plugged howitzer shells striking with low velocity, the effect on either material was insignificant.

4. All but one of the projectiles fired into sand had turned completely round, whereas none of those fired into earth had turned more than half round, except one 10-inch shell which had left the earth and entered the fine shingle portion of the parapet. This greater tendency to turn round in sand has doubtless an influence in restricting penetration.

5. The 6·6-inch gun and howitzer fire the same projectiles, viz.:—shells of 100 lb. weight; and as the striking velocity of the former (1452 f.s.) was considerably in excess of that of the latter (841 f.s.) it was but reasonable to expect greater penetration from the gun than from the howitzer shells, but the contrary was the case, *apparently*; *i.e.*, the howitzer shells were *found* further in the butt. This result is however, it is believed, to be attributed to the fact of 68 rounds of filled and fuzed shell having been fired into the butt between the penetration trials of the two pieces named; consequently projectiles already in the butt may have been considerably disturbed by the bursting shells.

6. The penetration of the 6-inch B.L. Palliser shells into sand were curiously small considering their high striking velocity.

Trials for disruptive effect.

The same pieces fired filled and fuzed shells for disruptive effects as were used in the penetration trials, viz.:—10-inch, 6-inch, 6·6-inch guns, and 8-inch and 6·6-inch howitzers.

For these trials the butt was reduced to a thickness of 30 feet, exclusive of slopes, the projectiles used against it were filled common shells with quick fuzes except in one series when common shells with delay-action fuzes were fired from the 8-inch howitzers.

The following table gives the striking velocities, bursting charges and amount of earth or sand displaced by the rounds from each piece:—

TABLE OF ORDNANCE,

SHOWING

Bursting Charges of Shells, Striking Velocities, Amount of Material Displaced, &c.

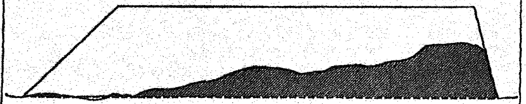
Ordnance.	Charge.	Projectile. Nature.	Projectile. Weight.	Bursting charge.	Fuze.	Striking velocity.	No. of rounds fired.	Nature of parapet.	Material displaced.	Remarks. Range ... 195 yards
	lb.		lb.	lb.					cubic yds.	
10-inch gun ...	95 P^2	Common shell, filled.	408	$20\frac{1}{4}$	Direct-action. (Quick.)	1416	3	Earth.	63	Through in 2 rounds. Effect almost entirely produced by 2 rounds.
"	"	"	408	"	"	1416	3	Sand.	24	
6·6-inch gun ...	25 P.	"	100	$5\frac{1}{2}$	"	1452	12	Earth.	17	2 rounds fired with R.L. fuzes were blind. They displaced, however, 3·7 yards of earth.
6-inch B.L. ...	34 P.	"	80	5	"	1875	10	"	16	Shells broke up on impact.
"	"	plugged.	80	Nil.	Nil.	1875	10	"	12	
8-inch howitzer ...	$11\frac{1}{2}$ R.L.G.^{2}	filled.	180	14	Direct-action. (Quick.)	921	10	"	54	Through in 8 rounds.
"	"	"	180	14	Delay-action.	"	10 5 effective.	"	27	Through in 7 rounds. 3 blind, 2 burst with delay "en ricochet," 1 burst on impact, 4 with delay in parapet.
"	"	"	180	14	Direct-action. (Quick.)	"	10	Sand.	18	
6·6-inch howitzer	5 R.L.G.^{2}	"	100	$5\frac{1}{2}$	"	841	10	Earth.	12	

Diagrams to Illustrate the Relative Effects produced in Earth and Sand Parapets.

Ordnance.

10-in. R.M.L. Gun of 18 tons ....

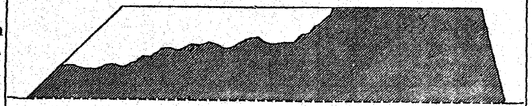
3 rounds Common Shell, Delay Action Fuze, at *Earth*.



3 rounds Common Shell, D.A. Fuze, at *Sand*.

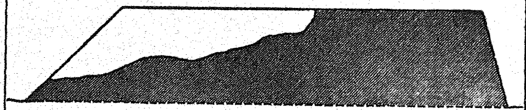
6·6-in. R.M.L. Gun of 70 cwt. ....

12 rounds Common Shell, 2 R.L. and 10 D.A. Fuze, at *Earth*.

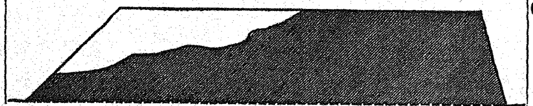


6-in. B.L. Mark I. Gun of 80 cwt....

10 rounds Common Shell, D.A. Fuze, at *Earth*.



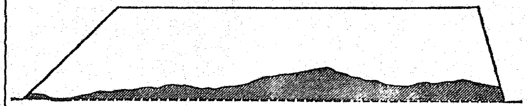
10 rounds Common Shell, plugged, at *Earth*.



Ordnance.

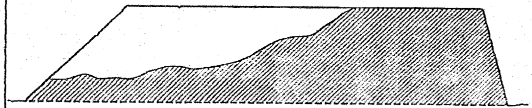
8-in. R.M.L. Howr. of 70 cwt.........

10 rounds Common Shell, D.A. Fuze, at *Earth*.



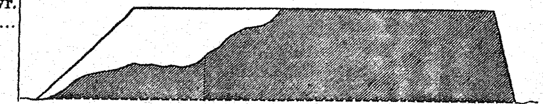
10 rounds Common Shell, D.A. Fuze, at *Earth*.

10 rounds Common Shell, D.A. Fuze, at *Sand*.



6·6-in. R.M.L. Howr. of 36 cwt. ....

10 rounds Common Shell, D.A. Fuze, at *Earth*.



From these experiments it appeared that,—

1. Parapets of sand exhibit a higher degree of resistance to shel fire than those of earth, both the penetration into, and the dispersion of the material being less in the former than in the latter case.

2. Shells of small capacity, whether striking with high velocity or not, are comparatively but feeble instruments for the destruction of earthworks; whereas *per contra*, shells of large capacity are very effective, even when their striking velocity is low.

3. The fact that velocity is a far less important factor than shell power, points to the advisability of employing howitzers in preference to guns for work of this nature: the advantages of large shell power, compared with weight of piece, belonging especially to howitzers.

4. The action of the delay-action fuzes was very uncertain. A comparison of the series with "delay" fuzes from the 8-inch howitzer, with a similar series from the same piece with "quick" fuzes, tends to show that the destruction of earthen parapets is more rapidly and completely effected with the latter than with the former. In the case of shells with "delay" fuzes, unless the angle of impact is very considerable, the shell is apt to scoop up and get clear of the parapet before bursting. This would be the case with all impinging on the superior slope, except when fired at high angles of elevation, and of those that strike the exterior slope, the first will probably enter well, and effect a large displacement of earth from the heart of the parapet[1] in the rounds immediately following the shells, if striking about the same spot will probably burst in or near the former crater and add but little to the effect already produced. As soon as the partially demolished parapet falls into easy slopes, the angles of impact of subsequent shell will be too small to enable them to penetrate, and they will consequently rise, burst clear of the parapet, and produce but little effect.

It would therefore appear doubtful whether, even if a thoroughly good delay fuze be secured for the service, shells so fuzed could be employed with advantage for the destruction of earthworks, except in the sole instance of high-angle fire for the destruction of over-head cover, when it is a desideratum that shells should burst at extreme penetration.

It is possible that good results might result from a combined fire of shells, some with quick and some with delay fuzes, (each nature being used according to the requirements of the case) for purposes of breaching earthworks.

It is worthy of remark that longer delay is needful in order to get full effect out of a shell when fired with low than with high velocity.

---

[1] Shells that acted in the manner indicated, moved an immense quantity of earth, far more than any single shells with quick fuzes did.

5. The highly destructive effects produced by the powerful shells of the 10-inch gun would appear to indicate the importance of mounting accurate pieces of large shell power on the land fronts of fortifications provided efficient means could be secured for their protection.

6. It is noticeable that there was no very marked difference between the effects produced by the 10 rounds of plugged shell and the 10 rounds of filled and fuzed shell fired from the 6-inch B.L. gun, owing to the whole of the shells in both cases breaking up on impact. Those that had powder in them had somewhat the best of it, as the powder did ignite and produce a certain amount of explosive force, though only to a very limited extent.

Caking of powder in shells.

An opportunity was afforded during these experiments of examining a blind filled common shell, which had been fired from the 10-inch gun at the earthen parapet. On removing the base plug and cutting away the serge bag, it was found that the bursting charge had been set back with such force into the base of the shell as to have become transformed (in that portion next the base) into so hard a mass, that even after having had water standing on it for a quarter of an hour, it resisted a sharp pointed knife like a piece of slate. It is curious that the bursting charge did not set forward into the nose of the shell on impact, and only to be accounted for on the supposition that the shell was brought comparatively slowly to rest in loose earth.

The fuze (direct-action) had acted and it is probably owing to the fact of the bursting charge not having set forward on impact, and to there consequently being a considerable air space between the highly compressed burster and the fuze, that the flash of the latter had not sufficient power to pierce the serge bag in which the bursting charge was confined.

Before these experiments were carried out it was urged by some that high velocity guns of medium shell power, such as the 6-inch B.L., would prove more effective for the destruction of earthworks, than low velocity pieces of large shell power, such as the 8-inch howitzer: the idea being that with the former pieces the parapet would be cut through in long grooves from the top downwards, and if the shells could maintain their original course after impact, it is quite likely that this result might be secured: but the fact is, that a shell with a flat trajectory, striking high up on the exterior slope, is immediately deflected upwards, and can consequently do but comparatively little work. It is almost needless to remark that those that strike on the superior slope have only a grazing effect. If, on the other hand, the shells are planted low down in the parapet, they are smothered to a great extent, or in other words have not the power to throw the superincumbent mass of earth clear away, and what earth they do lift, to a great extent falls back again.

It is true that in the experiments under consideration, the high velocity gun was heavily handicapped, from the fact of all its shells

breaking up on impact, when, although the powder ignited, there was no power of burst.

There are also two other things that tell against the high velocity gun, and they are these :—

1. As long as shell L.G. powder is used for bursting charges it will become more or less caked into a solid mass in the shell from the shock of firing, and the higher the velocity the more does the bursting charge become so caked, and consequently the more is the explosive power of the shell lessened. This is of course assuming that a sufficiently strong shell is secured to withstand the shock of impact without breaking up, for should the shell break up the condition of the bursting charge can hardly influence the result to an appreciable extent.

2. The shells with flat trajectory will always have a far greater tendency to scoop up out of the parapet than those fired from howitzers, and this will especially tend to detract from their effect when the disturbed earth of the parapet begins to fall into easy slopes. We have, at present, no data to enable us to state at what angles of impact, on ordinary earthworks, shells will enter fairly into the work instead of scooping up. On water we know that they will not ricochet when the angle of descent is as high as 11° or 12°, and it would be interesting to have similar information regarding their behaviour on earthen slopes.

One great advantage that high velocity guns have over howitzers, except at extremely short ranges, is their superior accuracy, especially under unfavorable atmospheric conditions. At long ranges in squally weather this has an enormous influence on the percentage of hits obtainable by the two classes of pieces respectively.

The idea that heavy earthworks are almost indestructible by Artillery fire, can no longer be entertained. We have seen how the 18-ton gun cut through a parapet 30 feet thick, exclusive of slopes, in 2 rounds, and the 8-inch howitzer did the same in 7 or 8 rounds, it is therefore perfectly evident that no earthwork can for long withstand the fire of powerful shell pieces, provided the following three essentials to effective fire are existent, viz. :—

1. The power of being able to accurately observe the point of impact, so as to be able to correct the laying.

2. An accurate shooting piece.

3. Large shell power.

In the case of the earthworks of Coast Defences it may be observed that they will always have this in their favour, viz. :—That they are only liable to be fired at by ships, which, although possessed of heavy

ordnance of large shell power, must always labour under the following disadvantages:—

1. The difficulty as to range, especially when the vessels are on the move.

2. The obscuration from smoke.

3. The difficulty, not to say impossibility, when several guns are firing at the same time, of any one in charge of a gun, ascertaining the point of impact of his own shot.

4. The fact of the guns being fired from a moving platform.

Consequently the two first essentials (accuracy of observation and of fire) can only exist to a very limited extent, and what shells do take effect will be scattered about over the works instead of hitting consecutively on the same spot, and hence concentration of effect, which is essential for breaching, will be wanting.

To be continued in a paper giving a précis of the 1882–83 Experiments.

BATTLE FIELDS

IN THE

LE MANS CAMPAIGN.

BY

CAPTAIN R. F. JOHNSON, R.A.

No. 5.

ARDENAY.

9th January, 1871.

To see the country over which the German centre column passed in its approach to the French position immediately in front of Le Mans a long walk is necessary if the site of the action of Ardenay is to be visited, but the whole of the ground to the west of that village can be very well seen from the Auvours Heights. The walk is, however, worth the trouble.

Take train to Pont de Gesnes (or Gennes). The station has been moved westward to near La Tuillarderie on the German official map, and a new bridge constructed leading direct to Montfort. On leaving the station, take the road between the railway and river as far as the turn to Pont de Gesnes, and then, turning to the right under the railway, bear to the left (S.E.) to La Belle Inutile, a small group of houses on the main Connerré-Le Mans road. The more direct road to Ardenay by Pré Haut farm, marked as a good one on the German map, is nothing but a muddy lane. The road from La Belle Inutile is that followed on the 9th of January by a flanking detachment of Germans of one battalion, two squadrons, and four guns. These troops, having driven some Franc Tireurs out of Nuillé, and had a sharp skirmish on the high ground near the Mauguilinière farm, met with some resistance at La Belle Inutile, but captured it, and secured a considerable convoy belonging to the French troops who were about Connerré, four miles north-east. La Belle Inutile is quite indefensible, being completely commanded by high ground, at a short range. Having ascended the hill Mauguilinière is reached at one mile from La Belle Inutile. The country is cultivated in very small enclosures, and to the north-east is very much wooded. On the 9th of January it was full of wandering bands of French irregular troops. The head of a valley running up from the south-west is crossed, and then a straight narrow ridge running in the same direction as the valley, which

commences at Ardenay, two and a-half miles on the right (S.W.). A broader valley is now entered. At two and a-half miles from La Belle Inutile, Nuillé (500 inhabitants) is passed three-quarters of a mile on the left, and Soulitré (700 inhabitants) the same distance on the right. At three miles Le Breil is reached, a large village (1700 inhabitants) surrounded by high ground on the north-east and west, and looking down a wooded valley towards Ardenay on the west. Thorigné, where the left of the German right column fought on the 9th of January, is distant three and a-half miles to the north-east. In Le Breil, take the first turn to the right after passing the church and go due south through the village, and bearing to the right just outside go along the good road to Gros Buisson on the main road to St. Calais, along which the Germans advanced. Turn to the right (W.). The road running between two rows of poplars is quite straight and almost level, but the view is limited by two knolls on the right, a ridge two miles in front, and another and larger ridge covered with forest running parallel to the road on the left. The road south leads over this last ridge to Surfonds (400 iuhabitants), which lies two and a-half miles off in the valley of the Sourice brook, a small tributary of the Narais river.

On the 9th of January the Germans, after a march of six and a-half miles, reached the cross-roads, where you stand, and found the knolls on the right occupied by French Mobiles, which, according to their own accounts, numbered about 400. One and half battalions of the Germans deployed, and, after a sharp fight, carried the position at 2 p.m., and then found the road barred by a strong force on the ridge to the westward.

Proceed westward. After passing the knolls the ground is flat on the right, and at the present time fairly open, but in 1871 it was covered with a good deal of wood. The ridge in front runs to the north-east, and so takes the road in flank; but this formation of ground also exposes the left of a force defending it. Along the foot of this ridge runs a line of marshy meadows, drained by a small water-course. All the ground on the left of the road is covered with fine forest trees. Ascend the ridge by the old line of road through the hamlet of La Butte, and turn to the right (N.E.) along the crest for a few yards until an open field of view is obtained, and then face towards the line of the German advance (E.). The ridge is fairly open, but on the left some large hedges separating the enclosures run perpendicularly to the front, and with some small copses limit the view. On the left front is a valley opening out to the N.E., in which everything is hidden by trees; but far away on high ground can be seen houses above Nuillé, on the route of the German flanking detachment. In front, 2400 yards distant, are the knolls before mentioned. On the right front, 1300 yards away, is the Chateau d'Ardenay, a very large country residence with two wings and some large out-buildings. It stands on the end of the ridge south of the main road against the western end of the forest. The village (400 inhabitants) is 750 yards west of the Chateau in the midst of orchards and gardens low down on the southern side of the ridge. On the right the La Butte ridge

falls away into the broad valley of the Narais. Directly in rear is a large open plain, which is traversed in a north-westerly direction by the Narais, and was in 1871 covered with a forest of fir trees. This plain is bounded on the west by the Auvours Heights six miles off.

All the night of the 8th of January weary French troops were plodding along the straight interminable road from the west to block the advance of the enemy by holding the ridge of La Butte and Ardenay. The strength used was a whole Division under General Paris, which should have numbered 12 Battalions and 3 Batteries, or 8900 men at least. The whole were not up until 11.30 a.m. on the 9th, when a Battalion was placed in the Chateau d'Ardenay and 400 Mobiles were sent to the knolls north of the main road, while the remainder were distributed along the ridge of La Butte and in the village, while three light guns and a mitrailleuse were placed so as to sweep the road.

The sky is dark and the snow falling fast, when at 1.30 musketry is heard to the eastward and some cannon shots far away on the right (?). Nothing can be seen clearly at any distance; but, in half-an-hour, the Mobiles begin to come in on the left and the enemy appear on the knolls behind them. Soon 2¾ Battalions of Germans are deployed across the road, on which two light guns have come into action. Probably the state of the ground and fatigue of the horses or the falling snow prevent the use of the knolls as an artillery position, as they otherwise appear eminently suited for the purpose.

The French and German guns fire at one another for half-an-hour, when the mitrailleuse moves away and the Germans' guns retire; the first most likely has run short of ammunition, or is withdrawn to be kept intact for the closer combat, and the latter probably find they are not doing much good in the snow; but both claim to have driven the other off the ground.

The attack does not make much head; but at 4 p.m. half a Battalion reinforces its left, and with about one Battalion the Chateau is carried and a forward impulse is given to the line. Two and a-half Battalions make their way among the strips of trees north of the road, and three-quarters of a Battalion creeps across the meadows on the right.

The French now descend and make a vigorous counter-attack, but only check the advance for a few moments, while their left is threatened.

Darkness now comes on and finds the French Division tired out and dispirited, with all its units engaged or beaten, and the Germans moving steadily onward, with three-quarters of a Battalion in front of Ardenay village, three-quarters of a Battalion just east of the bridge over the stream in front of La Butte, and three-quarters of a Battalion firmly established on the ridge near the French left. General Paris determines to retreat, and by another long night-march reconduct his men to the main position, six miles in rear. How can his men be expected to fight to-morrow?

To cover the commencement of the retreat, some Infantry are launched down the steep road through La Butte to drive back the enemy at the point of the bayonet. The impetus of the tired troops

is soon lost, and the stroke does not reach far, while into the German centre a fresh half Battalion is brought up, which, carrying another half Battalion with it in its rush, charges with a cheer up the hill, and without a shot drive the last Frenchmen into the low ground beyond. By this time, the German Companies, Battalions, and Regiments are all mixed up, and so do not attempt to molest the retreat, but seek to re-form, and to pass the night under shelter in preparation for the stiffer work before them to-morrow.

To return to Le Mans follow the main road, which is quite straight for six miles, to Yvré l'Evêque station at Lune d' Auvours, and thence take train.

Leaving La Butte, the road traverses the perfectly flat plain which, in 1871, was covered with the forest of St. Hubert. If it had been Americans who were fighting the Germans, there would have been line upon line of abattis and trench, and the six miles from La Butte to the Huisne, if a circuitous route had not been found, would have taken days to cross instead of hours. Though no trees fell to bar the invaders' advance, the whole have been since cleared away to form an Artillery practice ground, where Frenchmen can be trained to prevent a recurrence of the disaster or in anticipation of revenge.

The Narais, a deep, swift stream about 10 yards broad, is passed on a stone bridge, beyond which branches off a track to the south-west, which, after passing through a gap between the Loudon Forest and Rossay ridges, leads to the village of Changé, and was the route of half the German troops starting from Ardenay on the 10th of January.

On the right is the high headland crowned by the chapel of St. Denis du Tertre, separated from the St. Calais road by the mouth of the cultivated valley running up to the north-east behind the ridge of La Butte. On the left is the valley of the Narais, which may be taken as representing the front of the German centre on the early morning of the 10th January.

The plain is bounded on the south by the north end of the Loudon forest ridge and the ridges of Rossay and Le Beauvais, which are about 2000 yards from the road at the Narais bridge, but approach within 500 yards of it five miles further west. On the north, the plain runs into the valley of the Huisne about St. Mars la Bruyère, whose new church tower is a prominent landmark. St. Hubert des Rochers is a small old farm building alongside the road, giving one the idea of having been some part of a chapel at a distant date; the reason for the halt in the advance on the 10th January being made near here is explained by there being a slight rise just to the west.

The end of the Beauvais ridge appears as if it would afford a view of all the right half of the French main position, but everything to the south of it is hidden by trees, and the view of the Auvours Heights is no better than that obtainable from the road.

The length of the walk from Pont de Gesnes by Le Breil to Yvre l'Evêque station is about 15 miles.

(To be continued.)

WAR SERVICES

OF

CERTAIN OFFICERS OF THE REGIMENT WHICH ARE NOT GIVEN IN KANE'S LIST, AND OF CERTAIN OTHERS WHICH ARE ONLY IMPERFECTLY GIVEN.

COMMUNICATED BY

GENERAL SIR J. H. LEFROY, C.B., K.C.M.G., F.R.S., R.A.

No. 2.

GENERAL FORBES MACBEAN,

WHO DIED IN 1800.

(After an old printed document).

DATES OF COLONEL MACBEAN'S COMMISSIONS, &c.

	Regimental.	Brevet.
Cadet's Warrant	July, 1743.	
Lieut. Fireworker	March 25, 1745.	
First Lieutenant	March 1, 1755.	
Captain Lieutenant	April 1, 1756.	
Adjutant	April 1, 1756.	
Captain of a Company	Jan. 1, 1759.	
Major	Jan. 19, 1780.	July 23, 1772.
Lieut.-Colonel	Dec. 3, 1781.	Aug. 29, 1777.
Colonel	Dec. 1, 1782.	Nov. 26, 1782.
A Deputation to act as Judge Advocate	May 9, 1758.	

JULY 16, 1743, Colonel Macbean entered in the Royal Regiment of Artillery as Cadet, and while he continued in that station attended the Royal Academy diligently, which procured him the favor and attention of Mr. Muller, who being pleased to recommend him to the Duke of Montague, then Master General, his Grace was pleased to appoint him a Lieut. Fireworker, by his commission, dated the 25th of March, 1745, and to order him to repair to Flanders. He embarked on the 30th of that month, joined the Corps of Artillery, then in quarters in Ghent, and commanded two guns on the 30th of April at the battle of Fontenoy.

On the return of the British Troops from Flanders, in October 1745, on occasion of the Rebellion, he served with a Corps of Troops consisting of 18 battalions and 12 squadrons, which assembled at Lichfield in November, under the immediate orders of His Royal Highness the Duke of Cumberland; and on the retreat of the rebels towards Scotland, was employed in the latter end of December at the siege of Carlisle.

In June, 1746, he embarked with a Corps of Troops under the orders of Sir John Legonier, Lieut. General, for Brabant, and in July joined the Allied Army commanded by Prince Charles of Lorraine, at Terheiden Camp near Breda; served all that campaign, and was present at the Battle of Raucoux, September 30th, commanding the battalion guns of the 19th Regiment, with five other battalions posted in that village under the orders of Major General Lastroro, sustained the attack of four of the eight great columns formed by the French army on that occasion, being the first coup d'essai of Mareschal Saxe in the attack by columns.

He served during the campaign of 1747 in Brabant, and was at the battle of Laffeldt, June 11th, commanding two guns, which were employed with others in cannonading the village of Rempst the evening before that battle; and was next day posted with the 25th Regiment in the village of Laffeldt, in the defence of which village almost all the Infantry of the left wing were engaged that day.

He remained serving in the Allied Army in Brabant till the conclusion of the Peace of Aix la Chapelle in November 1748.

In 1752, on Colonel Caroline Scott being appointed to command the East India Company's Troops, he applied to Generals Belford and Nicholson for an officer whom they could recommend to command the Artillery in that service, they were pleased to name Colonel Macbean then a Lieut. Fireworker; but another officer was in the mean time recommended by His Royal Highness the Duke of Cambridge, on whom Colonel Scott was prevailed on to confer that command.

In 1755, the Lord Lieutenant of Ireland having applied for a detachment commanded by an officer, from the Royal Regiment of Artillery, to be sent to that kingdom for the purpose of assisting in training a Corps of Artillery to be raised and established there, General Belford chose and recommended Colonel Macbean, then a First Lieutenant, to command that detachment; but the Adjutancy of the Regiment falling vacant at that period, and the General putting it in Col. Macbean's option whether to purchase it or go to Ireland, he chose the Adjutancy which he purchased, but resigned without selling on his obtaining a Company in January in 1759.

He was then ordered with his company to Germany, and in April joined the Allied Army under the command of His Serene Highness Prince Ferdinand of Brunswick. He was immediately on his arrival at Manster ordered with his Company to join a Corps of Troops then

assembled at Lipstadt consisting of 12 battalions, 10 squadrons, and most of the light troops, under the orders of His Serene Highness the Hereditary Prince of Brunswick, and forming the van of the army. With this corps he remained commanding a Brigade of Light Infantry till these troops joined the body of the army in July, when he was appointed to the command of the heavy brigade of British Artillery which remained under his immediate orders during the campaigns 1759, 1760 and 1761, and performed considerable service on various occasions during the important operations in these campaigns, particularly at the Battle of Thannhausen, on the 1st of August 1759, at the affair of Warbourg on the Dymel in July 1760, and at the attack and taking of Fritzlar in February 1761 under the Hereditary Prince of Brunswick.

In February 1760 he was appointed by Lord Granby to do the duty of Major to the British Artillery in Germany.

In 1761, Colonel Macbean being obliged to return to England by the advice of Sir Clifton Wintringham and Doctor Knox for the recovery of his health, which was greatly impaired by his zealous exertions and the unavoidable fatigues of two successive winter campaigns. His Serene Highness Prince Ferdinand was pleased by his own mere motion to recommend him to the King for some mark of His Majesty's favour, and particularly to request that Lord Granby's appointment of Major might be confirmed by His Majesty's commission; but whatever His Majesty's intentions were, Colonel Macbean has never yet been honoured with any mark of His Majesty's gracious acceptance or approbation of his services.

In 1762 he was ordered with his Company to Portugal, and was appointed by the Earl of Loudoun commanding the British troops on that service, to do the duty of Major to the Corps of Artillery; was always with the Corps de l'Armée commanded by His Excellency Count La Lippe, commanding the British and Portuguese Artillery in every operation wherein they were employed. The Count La Lippe was pleased to write to the Earl of Egmont, then Secretary of State, requesting that His Majesty would be graciously pleased to confirm Lord Loudoun's temporary appointment by granting Col. Macbean a brevet of Major, which His Majesty graciously complied with. This was signified by letter from the Earl of Egmont to Count La Lippe, and the same was declared in the General Orders of the combined Army in Portugal, notwithstanding which no notification thereof was made to Col. Macbean from the then Master General's office, nor was any commission ever sent him as Major.

At the close of the campaign, 1762, Colonel Macbean had the honour of being presented by the Count La Lippe to the King of Portugal, and His Most Faithful Majesty was pleased to confer on him the rank of Lt. Col. in his army; and early in 1763 he was appointed Colonel of a Regiment of Artillery there. Application was at the same time made by Count La Lippe and the Court of Portugal to the Earl of Loudoun

that Col. Macbean might have permission to remain there, which His Majesty not complying with he returned with the troops to Britain.

At the latter end of the year 1764, upon an apprehension in Portugal of being attacked by the Spaniards, His Most Faithful Majesty applied by his Minister in London to the King that he might have His Majesty's leave to repair to Portugal to take command of a Regiment to which he had been formerly appointed Colonel, and to take the direction of all the Portuguese Artillery consisting of four Regiments. His Majesty having graciously consented to it, he repaired to Portugal, where, on his arrival, he was appointed Inspector General of all the Portuguese Artillery, by commission dated Jan. 1, 1765, and remained in Portugal above four years exercising the duties of that office to the satisfaction of that Court, as appears by a very handsome testimonial which he received on his resignation from the Conde d'Oeyras, Secretary of State.

In 1769, 70, 71, 72 and 73 he was with his Company in Canada.

In 1774, 75, 76 and 77 he was with his Company in Great Britain.

Colonel Macbean never was on half-pay, but always attended his duty diligently.

In March 1778 the Master General Lord Townsend signified His Majesty's pleasure that Col. Macbean should succeed Major Gen. Phillips in the command of the Artillery in Canada, and in April following he embarked with General Haldimand for that province.

During the campaigns in which he served in Germany and Portugal last war, Col. Macbean had the honour to receive very particular acknowledgments and marks of approbation of his conduct, from their Serene Highnesses Prince Ferdinand of Brunswick, the Hereditary Prince of Brunswick now reigning Duke, their Excellencies the Count La Lippe, Lord Granby and Lord Loudoun, and from every General Officer under whom he has had the honour of serving.

In the winter 1780, when General Haldimann had reason to believe that Canada was to be invaded, and made the necessary preparations accordingly, His Excellency did Col. Macbean the honour of appointing him to command a Brigade of Infantry in a very large district, on that part of the frontier which covers Sorell, the great place d'armes, and His Excellency has been pleased to express his perfect approbation of his services, on that as well as on various occasions, particularly in his letter to Lord Townsend, Master General.

Dans l'ordre de jour adressé par le Prince Ferdinand de Bronsvic aux Officiers de l'Armée Britannique, son Altesse Serenissme a voulu de sa propre main ecrire la lettre suivente au Capitaine Macbean,

laquelle-lui à été rendue par son Excellence le Comte de la Lippe Buckeburg, Grand Maître d'Artillerie de l'Armée Alliée :—

Au Capitaine Macbean, Artillerie Royale Britannique.

MONSIEUR,

C'est pour rendre justice au merite, et a la justice même, que je declarre par celle ci avoir lui d'etre infiniment satisfait de votre comportements, activité, et zêle, que vous avez d'une maniere si eclatante faits remarquer à la Battaille, du premier d'Aout, á Thannhausen (Minden). Les talens que vous possedez dans le metier que vous exercez n'onts pas peu contribuées a rendre notre feu superior à celui de l'ennemie, et c'est à vous, et à votre Brigade, que je suis redevable pour avoir etient et rendu muet le feu d'une batterie ennemie qui causoit beaucoup de tort aux troupes, et nommément a l'infanterie Britannique.

Reçevez donc, Monsieur, le juste tribute de ma parte d'une reconnoissance la plus parfaite, accompagnée de remercimens les plus sinceres. Charmé si je trouverai des occasions pour vous obliger, ne desirant qu'elles se presentment pour le prouver.

Etant, avec un estime très distinguée,

Votre très devoué et à fait affectionné Serviteur,

FERDINAND,

Duc de Bronsvic et de Lunenburg.

(True Copy) WM. MACBEAN,

Colonel.

PRACTICAL RULE

FOR

RANGE-FINDING.

BY

CAPT. P. A. MACMAHON, R.A.

THE following practical rule for range-finding with the sextant, when the vertical angle is less than 5°, and the triangle nearly isosceles, may or may not be well known. It is *very* accurate, and only requires quarter of a minute on the back of an envelope :—

Multiply the base in yards by 57·3, and divide by the vertical angle in degrees. The result is the range in yards.

Ex. gr.:—Base 50 yards.

Vertical angle, 1°.

$$\text{Range} = \frac{57{\cdot}3 \times 50}{1} = 2865 \text{ yards.}$$

PRÉCIS

AND

TRANSLATIONS.

FRANCE.

I.

REGULATIONS OF AUSTRIAN ARTILLERY.

BY

MAJOR H. H. COSTOBADIE, R.A.

PRACTICAL INSTRUCTION IN SIEGE AND FORTRESS ARTILLERY.

FROM A TRANSLATION BY CAPTAIN BODENHORST.

THE object of the above is the proper teaching of the personnel of Garrison Artillery in all matters pertaining to their duties in time of war.

To afford such instruction every garrison should contain all kinds of equipment connected with the attack and defence of fortresses. The Senior Staff Officer of Artillery in a district should be responsible that every garrison in his command carries out its annual course; but the actual instruction should be under the superintendence of the Senior Artillery Officer in the Garrison undergoing that course. The latter Officer should start with an hypothesis, and lay out an imaginary plan of attack and defence, such plan being one likely to be carried out in time of war. For instance, if the men under his command be numerous enough, he might at one and the same time carry out practical instruction in the attack and defence, if not, he might carry out imaginary; but likely operations in the one first and then in the other, drawing up data somewhat as follows:—

I. *For the Artillery of the Attack.*

1. Given a certain front of the place to be attacked, or certain forts of the intrenched camp belonging to it.

2. The situation and description of provisional works of the above-mentioned intrenched camp—works which would only be constructed in time of war.

3. The situation and extent of investing lines, with a topographical description of the whole country included by them.

4. An exact description of the whole country defended by the fortress, and of the actual ground in its neighbourhood occupied by the defence.

5. The strength of the Artillery of attack in personnel and equipment.

6. The spot, or spots, where the whole Siege Train, or its several parts, are to be temporarily collected.

7. Full instructions as to the nature of the works to be attacked, &c.

8. The site and extent of the parallels of attack, communications, &c.

II. *For the Artillery of the Defence.*

1. The site and nature of provisional works which would only be constructed in time of war, and the means to be employed to strengthen certain others.

2. The armament of the place in personnel and equipment.

3. The extent of ground to be defended inch by inch. A description and detailing of spots, plans, &c., to be occupied and placed in a state of defence by troops of the garrison.

4. The places where in time of peace and war are stored all material belonging to the Artillery of the place.

5. The telegraph stations, whether electric or other. The communications between them.

6. The most advantageous spots for detached posts and points of observation.

Experience shows that in the attack and defence of fortresses the most important operations are likely in the future to be those carried out in the beginning and not at the end of a war. It behoves us, therefore, to lay great stress upon the practical instructions of officers and men of the Artillery in all matters pertaining to preparation for defence from the moment troops are put upon a war footing, and in all matters pertaining to the attack betwixt the investing of a fortress and the opening of fire from the Batteries in the second position.

Given certain data, as above proposed, Officers carrying out the plan of attack should be instructed in the means to be employed for procuring revetting materials, in the transport of material by rail, water, or road from the depôts to the fortress, and in the choice of points of disembarkation; in the choice of sites for Batteries, and in their construction; in all matters pertaining to the disembarkation (by which I also mean unloading, &c.) of Siege Train material, to its transport, to the choice of ways and means for the same, to reconnaissance

generally, and to works of repair. Besides the above, they should know how to choose sites for intermediate depôts, and how to supply them from the grand depôts. They should know how to determine the first positions for the Artillery, the object of the same, and their armament. They should know how to construct the Batteries required, how to arm them, how to conduct the fire when once opened.

In the same way, they should be thoroughly instructed in everything pertaining to the second position of the Artillery of the attack, in all matters connected with breaching Batteries, indirect fire, counter Batteries, and the crowning of the glacis; in the utilization of conquered forts, &c., against a second line of defence, &c., &c. On the defence, Officers should be instructed to be prepared to dispose of their Artillery against a surprise, a *coup de main*, or against approaches. They should know how to prepare ramparts for defence by Artillery, and be able to make a choice of positions for field or other guns outside the works to co-operate with Infantry in detached posts, &c. They should be thoroughly instructed in the formation of magazines and their replenishment, in their duties connected with the service of all guns in the fortress, and of any used in sorties. They should thoroughly understand how to annoy the enemy's Batteries, whether in their first or second position; they should be ready with expedients to continue the struggle even after the enemy has established a superiority of fire over their own, and know how to oppose breaching Batteries, and how to bring their guns to bear upon forts conquered by the enemy, and how to make use of their guns in the defence of breaches, &c. They should understand how forts yet unconquered should co-operate in opposing an attack upon a second line of defence, &c., &c.

RUSSIA.

I.

VOJENNI SBORNIK.

SIX OR EIGHT-GUN BATTERIES?

A Précis from Major Zadowsky's German Translation,

BY

LIEUTENANT V. F. W. A. PAGET, R.H.A.

An article by M. A. Zinovef in last year's "*Vojenni Sbornik*" on the "Tactical units of Field Artillery," has caused a great sensation in the Russian military world, and the subject of reducing the Russian eight-gun batteries to six guns has been freely ventilated. It is not our intention to raise a discussion on this subject, but it may interest our readers to show the manner in which the author handles this subject, and brings out, in a new light, the division of the Arm into tactical units, on the basis of the "Fire tactics" of modern Artillery.

Zinovef begins by stating that the handling of "Units of Artillery"[1] has not been sufficiently gone into by tacticians; while the specialists in Artillery, on the other hand, only trouble themselves about the material factors of the arm, such as the time of flight and the probability of fire.

Experience shows that the best method of carrying on practice is to fire one gun at a time, pausing between each shot to give time to observe the effect and correct any error. No shot should be fired without the sanction of the Battery Commander. Of course, there are times when this rule would not be observed; for instance, with case shot.

In order that a body of Artillery may be regarded as a tactical unit, it is necessary that, under ordinary circumstances, the fire should be as rapid as possible.

[1] The difficulty most readers will experience in following the original writer in the above remarks, results from his not having had the goodness to state what he means by the word "Unit;" a word which in its way has caused as much confusion as the word "idea." A Division is a Unit; a Battalion is a Unit; a Company is a Unit. The Unit M. Zinovef is searching after appears to be, "the least number of guns from which a continuous fire can be kept up without exhausting the men."—*H. W. L. H.*

The chief factors, then, in the solution of the problem are the time required to load and the time necessary for the Battery Commander to "observe the effect," &c.

After many experiments it has been found that the time necessary to re-load a gun with common shell, after it has been fired, is about 1 minute, and with shrapnel from $1\frac{1}{4}$ to $1\frac{1}{2}$ minutes. These experiments were conducted under normal conditions, and care was taken not to exhaust the men too much. On the other hand, it appears that the time necessary between firing any two guns in a Battery is from 15 to 18 seconds, which gives us about 4 shots a minute. In cases in which rapidity of fire is of great importance, and in which no regard is shown for the physical strength of the detachment, a rapidity of five shots a minute may be attained.

With the help of these data Zinovef tries to establish the number of guns of which a Battery should be composed. A Division of two guns should not be a tactical unit, because there would be a pause of nearly a minute between the time of firing the second gun and making ready the first, during which it would be entirely defenceless. A four-gun Battery fulfills the required conditions, as the first gun would be again ready by the time that the effect of the fourth shot is observed. But a Battery of this sort could not, even under the most favourable conditions, continue an uninterrupted fire for any length of time, without exhausting the strength of its men. The slightest thing, even unfavourable ground, would materially slacken its fire. A line of skirmishers pushed rapidly forward against such a Battery would suffer very little except from chance shots and splinters, until it came within case range. A four-gun Battery, therefore, can hardly be called a tactical unit.

With an eight-gun Battery, there will of course be no slackness in fire; but however rapid the fire may be, it cannot exceed the normal rate of 4 shots a minute, although the Battery will always have 2 or 3, perhaps even 4 guns ready to be fired at any particular moment. A case will often occur in which a particular gun will have to wait perhaps a whole minute before its turn to fire. This Battery will be unable to use its whole strength with advantage, as a certain number of its guns will always be "practically" out of action, and it cannot therefore be regarded as the best tactical unit.[1]

A twelve-gun Battery would suffer in a much greater degree from the above cause; besides which the difficulties of working with such an extended front as it would require are well nigh insurmountable.

---

[1] Napoleon says:—"Gribeauval fixed the size of a Battery at 8 guns, because, 1st, such a Battery can be divided into 2 or 4 parts; 2nd, it can be served by a Company of 120 men, with a reserve in rear (ayant en reserve une esconade au pure); 3rd, it can be horsed by 1 Company of 'equipage du train;' 4th, a good Commander can handle such a Battery; 5th, it furnishes sufficient work to 1 forge 'et une prolonge,' and 2 spare carriages are sufficient for it. If the Battery is smaller, the army is burdened with more forges, more 'prolonges' (ammunition wagons), and more spare carriages."—*Correspondence de Napoleon I., tom. XXVI.*, p. 325.—*H. W. L. H.*

From the above it would appear that a four-gun Battery is too small, and an eight-gun Battery too large to carry on an Artillery combat with the greatest advantage; it follows, therefore, that six guns would be the proper number.

According to the data we have been using, a six-gun Battery can keep up a continuous fire at the rate of 4 shots a minute, without throwing undue strain on the gun detachments; and even in cases where all other considerations have to be sacrificed to rapidity of fire, it would be capable of firing at the rate of 6 rounds a minute. Now, under ordinary circumstances, an eight-gun Battery would not be able to fire more than 4 rounds a minute; therefore, as regards tactical units, a six-gun Battery is fully equal to one composed of eight guns.

Supposing we have two adversaries, whose strength in Artillery is 24 guns each, but the Artillery of one is composed of 3 eight-gun Batteries, while that of the other is composed of 4 six-gun Batteries,—a casual observer would be led to believe that the strength is equally divided, but this is not the case: the Artillery of the former would be weaker by $\frac{1}{4}$ than that of the latter. Of course the above applies only under what the author calls "normal circumstances," and there are many cases in which this would not hold good, notably when firing with case shot.

The advantage of six over eight-gun Batteries is even more apparent when we take into consideration the circumstances that determine the tactical units in other Arms.

One of the first principles of tactics is that no unit should be too large for one man to personally superintend. Now, the front of an eight-gun Battery is about 170 paces;[1] so that a Commander, who has taken up a position of observation on one flank, would have to communicate his directions to men about 200 paces off: these directions can be very easily misunderstood, and hence we have a very fruitful source of slackness of fire.

Experiments which have been made have proved that the fire of a four-gun Battery is fully equal to that of one of eight guns, in fact, the delays in the latter were the most frequent of the two, and the reason always proved to be some mistake in understanding an order which had been given from a distance.

In manœuvring, in spite of the simple words of command, it is very difficult for a Commander to drill an eight-gun Battery properly without certain signals; and under unfavourable circumstances, such as a high wind, &c., it is well nigh impossible.

The inconvenience of an eight-gun Battery is still greater in the field, where its carriages, 27 in number, take up 800 paces of the road, and the slightest obstacle drags out its length up to 1000 paces.

---

[1] 24 paces is allowed between each gun in the Russian Artillery.

The shortcomings of eight-gun Batteries were so great that they outweigh by a great deal the advantages which they may sometimes possess; the author therefore declares that as a fighting unit also, six and eight-gun Batteries are of exactly the same value.

Some defenders of the eight-gun system urge that in the event of one or two guns being put out of action, the Battery would still be in a fit state to continue its fire without material difference in its effect. But they seem to forget that in nearly all cases in which field guns have been put *hors de combat*, it has been due to the loss in men and not in material. Saddling a Battery with such a reserve of guns seems therefore in the highest degree irrational.

The author closes his article by proposing to take away 2 guns from each of the 300 Russian eight-gun Batteries, and forming 100 new Batteries of six guns each.

SPAIN.

I.

REVISTA CIENTÍFICO-MILITAR,

JULY, 1884.

BY

CAPTAIN J. C. DALTON, R.A.,

(D.-A.-A.-G. AND Q.-M.-G., GIBRALTAR).

THE NEW PRISMATIC POWDER ADOPTED BY SPAIN, AND ITS EFFECTS ON THE BALLISTIC CONDITIONS OF CERTAIN GUNS IN THE SPANISH SERVICE.

ON the 10th March, 1884, the Director-General of Artillery at Madrid was authorized to procure direct from the works at Hamm of the "United Rhenish Westphalian Powder Manufacturing Company" over 15 tons of *chocolate* prismatic powder. Of this, one-fourth was for the gun factory at Trubia, and the remaining three-fourths are, doubtless, for the charges of the new Krupp guns recently purchased for coast defence. This new powder has been adopted into the service, and it is therefore proposed here to give some details of its properties which may be interesting. The manufacture of the powder is kept a secret, but it appears to consist mainly in the special preparation of the charcoal, which is rich in oxygen. The prisms are hexagonal, one inch in height, the side of the base being four-fifths of an inch; there is one central channel of about 0·4 inch diameter, and the specific gravity varies from 1·80 to 1·86 in the different specimens. The following advantages are claimed for this powder:—

(1.) A great force of projection, producing large initial velocities and moderate pressures.

(2.) It explodes only in closed spaces; in the open air it burns slowly, thereby ensuring safety.

(3.) Little smoke, quickly dissipated.

(4.) Very slight residue left in bore, avoiding thereby the necessity of constantly cleaning.

(5.) It can be accommodated to large and small calibres.

On the 5th November, 1883, a comparison was made in Essen of the chocolate powder and the black prismatic powder.
Here will be seen the results :—

Gun.	Powder.	Weight of Charge.	Weight of Projectile.	Initial Velocity.	Interior Pressure in Atmospheres.	
					Rodman Apparatus.	Crusher Apparatus.
		lbs.	lbs.	f.s.		
Krupp 10·2-in., length 35 calibres, bought by Spanish Government	P.P. C/82. H. 336, chocolate	183·2	615·8	1768	2,490	2,480
	P.P. C/80. H. black	183·2	615·8	1732	2,610	2,640

The advantages of the chocolate over the black powder are plainly shown by these results, viz., that the former gives a greater velocity and less pressure with the same weight of charge and projectile. If the charge be increased up to 192 lbs., which is in reality the normal charge with this particular piece, we would probably obtain a velocity of at least 1800 f.s., and the pressure would not exceed 2700 atmospheres, which the gun is well capable of resisting.[1]

We should therefore obtain the following results :—

Distances.	Initial Velocity.	Total Energy.
yards.	f.s.	foot-tons.
0	1804	13892
547	1738	12894
1094	1676	11991
1641	1613	11365
2188	1555	10322
2735	1499	9592
3282	1443	8888
4376	1341	7676

Which are better than were stipulated for in the contract.

[1] Applying Erb's formulæ, we should obtain 1820 f.s. and 2667 atmospheres of pressure.

With these data we may fairly presume that the 10·2-inch Krupp B.L. gun will perforate the armour of the—

ENGLISH SHIPS:	*Inflexible*	up to 1094	yards.
	Majestic, *Ajax*, *Colossus*, and *Agamemnon* ...	" 2735	"
FRENCH SHIPS:	*Hoche*, *Magenta*, *Marceau*, and *Neptune* ...	" 1641	"
	Terrible	" 1968	"

But it would not perforate the armour of the four first-class Italian ironclads, nor of the French *Amiral Baudin*, *Formidable*, and *Amiral Duperré*.

The maximum range at 22° of elevation would be 12,679 yards, or, roughly, 7 miles.

We do not only find the advantages of this chocolate prismatic powder when used with steel guns, when power of resistance gives no reason to fear excessive pressures, but we find them also with wrought-iron guns, strengthened either in the interior or exterior, such as are at present manufactured in Trubia. For example, the tubed 9·8-inch gun, designed by Lieut.-Colonel D. Antonio Perez, gives much better conditions with this powder.[1]

The general ballistic conditions of this gun are to be as follows:—

Calibre, 10 inches.

Weight of Projectile, 397 lbs.

Weight of charge (Wetteren powder ·787 to ·984 inch), 140 lbs.

Initial velocity, 1804 f.s.

Pressure (maximum without premature deterioration), 2700 atmospheres.

By employing charges of 145 lbs. of the Hamm chocolate prismatic powder, No. 336, we may calculate that the following results should be obtained, viz:—[2]

Initial velocity, 1607 f.s.

Maximum interior pressure, 2439 atmospheres.

---

[1] Two of these guns were made as experimental in 1881–82. In 1882, tubes for them were got from the foundry at Creusot, and later, four more were ordered with tubes made by Whitworth. Owing to some difficulties, these guns are not yet finally proved. The 9·8-inch gun is of wrought-iron with two steel tubes, one extending the whole length of the gun, and the second placed over it in front of the trunnions. The interior tube is formed of several pieces joined, on account of the difficulties in the way of obtaining one single piece of the required dimensions. The total weight of the original gun is about 20½ tons, length 23 feet, length of bore 21·8 feet. These lengths have been increased in some of the later experimental pieces. It was made to take the projectiles for the 10-in. Armstrong gun, but now that for coast defence Krupp guns have been adopted, it is probable that it will be made to take the projectiles for the 10·2-inch Krupp gun. The breech-closing gear is on the divided screw principle with a Freire obturator.

[2] In this calculation, and in the following, we have used the empirical approximate formulæ of Erb.

$$V = K.\frac{C^{0\cdot6}.\ l^{0\cdot22}.\ s^{0\cdot05}}{u^{0\cdot225}.\ p^{0\cdot43}}$$

$$T = H.\frac{C^{1\cdot5}.\ p^{0\cdot3}}{u^{0\cdot95}.\ s^{0\cdot9}}$$

[Where

If we are permitted to suggest an additional 17·7 inches to the bore without altering the other conditions we could raise the charge to 198 lbs., and our calculation would then give the following results:—

Hamm Chocolate Prismatic Powder, No. 336.	Charge of 176 lbs.	I. V. = 1656 f.s. Pressure = 1950 atmospheres.
	" 187 "	I. V. = 1718 f.s. Pressure = 2120 atmospheres.
	" 198 "	I. V. = 1771 f.s. Pressure = 2320 atmospheres.

which are very satisfactory.

By using lengthened projectiles and this powder with the Perez gun of 10-inch we could get almost equally good results as with the Krupp gun of 10·2-inch.

Where

V = initial velocity.
T = interior pressure.
C = charge of powder.
p = weight of projectile.
s = area of a right section of bore.
l = length of the bore passed over by projectile.
u = volume of the powder chamber.
K, H = numerical co-efficients depending on the powder.

K and H have had to be determined owing to the powder being used in a gun with slightly different conditions. This was done by introducing into the formulæ all the known values. K and H thus obtained were employed in the new calculation.

NOTES:

BY VARIOUS HANDS.

The old Printing Machine having become worn out, the Committee have replaced it by another with the latest improvements, worked by a one H.P. Gas Engine, at an expense of £330.

The following Notice is re-published for the information of Officers Commanding Batteries :—

It has been found that two columns in the recently issued form, "The Royal Regiment of Artillery, by Seniority of Batteries," are practically useless; and it is proposed to utilise these two columns by converting them into one column, headed "Service in the Field," in which the battles, sieges, &c., in which the different Batteries have taken part, will be named in the same way in which the battles of the Infantry are mentioned in the Army List. This proposal can only be carried out by Officers Commanding Batteries sending to the Secretary a list of the actions in which their Batteries have taken part. It is hoped they will do so at their earliest convenience.

There has been recently published, by Captain F. C. Morgan, R.A., a "*Handbook of Artillery Matériel,*" which, in the present days of incessant change and infinite complications, will no doubt be found

useful by many officers. Price, 5/6: to be had through the Institution at trade price, 4/0, or by post (home) 4/3.

The scope of the book is best explained by the following extract from the Preface :—

"In the following work containing a short description of ordnance, ammunition, carriages, machines, and stores used in the service of Artillery, the compiler has endeavoured to provide in a concise and handy form the most important and most recent information.

"It is hoped that the Handbook may prove of use to those officers and others, who, from various causes, have not had the time and opportunities to keep themselves up to date with the constantly recurring changes."

THE "THURLOW R.A. WIDOWS FUND."

THIS Fund has been lately created by a gift of £1500 from Major E. H. Thurlow, late Royal Artillery. By the deed of settlement the interest on the capital is to provide annuities to three widows of N.-C. officers and men of the Royal Artillery.

The Committee of the R.A. Regimental Charities administer the Fund, and the Trustees are :—

General A. T. Phillpotts.
Lieut.-Colonel S. Parr-Lynes, R.H.A.
Major G. Parlby, R.A.

The following three annuitants have been recently elected, and have been in receipt of annuities since 15th October, 1884, viz. :—

1. A. Laing, age 76, widow of Gunner Laing, £20 yearly.
2. S. Double, age 80, widow of Gunner Double, £20 yearly.
3. E. Nairn, age 74, widow of Sergeant Nairn, £16 yearly.

A list is kept of candidates for election, and Officers who wish to recommend the name of any widow (over 50 years of age) for registration as a candidate, should communicate with Captain F. C. Morgan, Hon. Secretary, R.A. Regimental Charities, Woolwich.

POLO.

This is the second season that Polo has been played at Woolwich, and a short record of the matches may be of interest. A field in Charlton Park was hired, and the game has been played regularly twice a week. Lieut.-Colonel Studdy has again been the manager: a successful and pleasant season is due to his energy. Only one accident happened, and that occurred to Lieut. W. L. H. Paget. His pony came into collision with another, when playing against the West Essex Club, on July 3rd; they fell, and he unfortunately dislocated his shoulder, and broke his collar-bone.

RECORD OF MATCHES.

R.A., WOOLWICH, *v.* R.A., WEEDON.

16th May, at Woolwich.

R.A., Woolwich.	*R.A., Weedon.*
Lieut.-Colonel Studdy.	Lieutenant O'Neill.
Lieutenant Allsopp.	" M. Block.
" B. Lecky.	" De Robeck.
" W. Paget.	Corporal Wilson.

Won by the R.A., Woolwich, by 5 goals to none.

R.A. *v.* HERTFORDSHIRE.

4th June, at Hartham, Hertford.

R.A.	*Hertfordshire.*
Lieut.-Colonel Studdy.	Mr. F. L. Vaughan.
Lieutenant O'Neill.	Mr. W. A. Elin.
" B. Lecky.	Mr. E. Barnard.
" W. Paget.	Mr. A. Waters.

Won by Hertfordshire by 3 goals to none.

R.A. *v.* WEST ESSEX.

7TH JUNE, AT GAYNES PARK, EPPING.

R.A.	*West Essex.*
Lieutenant O'Neill.	Mr. A. Waters.
" B. Lecky.	Mr. Chisenhale Marsh.
" W. Paget.	Mr. T. Fowler.
" R. Heygate.	Mr. W. H. Sewell.

Won by the R.A. by 3 goals to 1.

R.A. *v.* 7TH HUSSARS.

20TH JUNE, AT WOOLWICH.

R.A.	*7th Hussars.*
Lieutenant O'Neill.	Captain Phipps.
" B. Lecky.	" Ridley.
" R. Heygate.	Mr. B. Mumm.
" W. Paget.	Mr. J. Reilly.

Won by the 7th Hussars by 4 goals to 1.

R.A. *v.* WEST ESSEX.

3RD JULY, AT WOOLWICH.

R.A.	*West Essex.*
Lieut.-Colonel Studdy.	Mr. A. Waters.
Lieutenant O'Neill.	Mr. S. Chisenhale Marsh.
" W. Paget.	Mr. A. Suart.
" R. Heygate.	Major Tait.

Won by the R.A. by 5 goals to 3.

R.A. *v.* HERTFORDSHIRE.

7TH AUGUST, AT WOOLWICH.

R.A.	*Hertfordshire.*
Lieut.-Colonel Studdy.	Mr. F. Vaughan.
Lieutenant O'Neil.	Mr. A. Waters.
" B. Lecky.	Mr. G. Holdsworth.
" R. Heygate.	Captain Wheeler.

Won by Hertfordshire by 4 goals to 2.

On September 19th, there was a tournament between three clubs—R.A., Hertfordshire, and West Essex—at Panshanger Park, Hertford, for a challenge cup. The R.A. were successful, with a score of 5 goals, Hertfordshire obtaining 4, and West Essex 2.

The sides were as follows:—

R.A.	*Herts.*	*West Essex.*
Lieut.-Colonel Studdy.	Mr. F. Vaughan.	Mr. A. Waters.
Lieutenant O'Neill.	Mr. E. Barnard.	Mr. B. Dickenson.
" B. Lecky.	Mr. G. Holdsworth.	Mr. S. C. Marsh.
" De Robeck.	Mr. W. Elin.	Major Tait.

The cup, which is of silver, stands twelve inches high, exclusive of its pedestal, and represents a bowl supported by three polo sticks bound together by a laurel wreath. It is now at the Mess at Woolwich.

On August 8th, some pony sports were held at Charlton Park, which were well contested.

ON

KEEPING BATTERY HORSES IN CONDITION.

BY

MAJOR T. B. TYLER, R.H.A.

I HAVE been asked to write my experience on the subject of keeping Battery horses in good condition; and, in the hope that my remarks will benefit some of my brother officers, I have complied with the request. But I wish it to be well understood that I lay no claim to have discovered any new thing; every officer who has had the chance may have learned what I have learned, and without doubt many have profited by their experience more than I. In our Regiment, however, there are officers who, for various reasons, have found their lot in early life cast in positions which have not brought them into contact with horses, and, perhaps, when they arrive at the rank of Major they are called upon to assume command of a Field Battery, and have to learn where they should be able to teach. For these men, and for young officers who have had no opportunities of acquiring stable knowledge, I write.

The business of commanding a Battery of Horse or Field Artillery is, now-a-days, one so various and complex, that it is not possible for a man, however zealous and capable, to fulfil entirely the many duties required of him. He finds himself at the head of two departments, the parade and the office, and there is not time for complete superintendence of both. If he elects to devote himself to the former, he must, to a great extent, trust his Quarter-Master-Sergeant and clerks; if to the latter, he must give large powers to his officers and Sergeant-Major. It is not my intention to trace the limit of separate responsibility which should be observed by a Battery Commander, and I shall content myself with remarking that I consider the men and horses my first duty.

It may be safely asserted that in any Battery two-thirds of the horses possess good constitutions, and will keep their condition well under proper treatment: but there are always a certain number which, from various causes, will not look well unless cared for with intelligent attention. On these weaker vessels the Battery Commander should bring to bear all his knowledge, and should seek, by enquiry and thought, to arrive at an estimate of their natures, and reason of existence of their weak points. It is a well-recognised characteristic

of human nature that, to a looker-on, your short-comings are more apparent than your excellencies, and under no circumstances is this unpleasant truth brought home to you with greater force then when a candid friend inspects your stables. You may show him four stables of well-looking horses, but if, in the fifth, there should unhappily be an ill-conditioned one, the fact will undoubtedly be brought to your notice. The matter is of very much greater importance than the opinion of your candid friend; but it is well to remember his existence and to do your utmost to take the wind out of his sails. When I observe a horse looking badly, I strive to find out why he looks so, and to devise some remedy or cure for his weakness. I examine his teeth; I look to see if his manger is clean; I ask whether he has been doing extra work, if he lies down at night—in short, I do all in my power to discover what is wrong. And if I am baffled for the time, I return again and again, till I am satisfied as to the cause of his falling off in condition. Any man with a fairly quick eye can detect a difference in a horse's appearance; and if the cause of change be discovered in its early stages, it can generally be accounted for, and further mischief prevented. A Battery Commander who acts on this principle will find, as I do, that his officers and men will learn his system and take care that he seldom has occasion to ask questions; for in a Battery in which the men take a pride in their horses, they feel it a personal slight to be told their horses are not looking well. But it must not be thought that because two horses get the same food and treatment they must necessarily carry the same condition; they differ greatly in character and constitution, and it is the cause of the difference which, as I tell my officers and men, it is their business and mine to find out.

Apart from actual illness, there are many reasons which may prevent a horse from putting on or keeping his condition: his teeth may be out of order; he may eat his litter; he may not lie down; he may not drink freely; he may be a crib-biter or a wind-sucker, or a weaver, or a nervous horse who wastes his food, or a slow feeder who allows his neighbours to steal his corn, or he may be viciously inclined and kick at night. All these faults, and there are others, can be met with and overcome by thought and patience. A fruitful cause of ill-health is the very common practice among battery horses of eating their litter; it is a hurtful one in several ways: the soiled straw is unwholesome and injurious to wind and stomach; a horse addicted to the practice keeps on picking at his litter when he should be lying down; he disarranges his bed, and when he does lie down it is on the stones, which chip his hips and rub the hair off other prominent points. So far as it can be prevented I do not allow my horses to eat their litter, and I stop them by placing the beds far back in the stalls, and shortening the head-collar chains so that the straw cannot be reached. The length of the chain is regulated by an oblong link let into it four feet three inches above the log, through which it is passed; it would be well if all stable head-collar chains were cut to this length, there is no use in the long chain, and it is obvious that the longer it is, the less power is exerted by the log in pulling it down, and the more chance

there is of the horse getting cast over it. The clean straw should always be well mixed with the soiled, so that the litter should be as little tempting as possible. A crib-biter or a wind-sucker seldom carries condition; and it is difficult to cure a horse who has become confirmed in the habits; it is a good plan to turn him round on the pillar chains whenever possible. I have known a horse forget the practice when so treated. A weaver should be turned round in like manner. A delicate feeder should be fed in small quantities several times a day, and tempted by such variety as is practicable, such as damping his food, or mixing a little grass with it. If you can once get a horse to feed well he generally continues to do so. Some horses kick in the stable, and not only injure themselves, but disturb their neighbours; to prevent this habit, strap a small log above the hock, or fasten a rope between the heel posts about six feet above the ground, from which hang strings with bits of wood attached; for an incurable kicker put on heel ropes as in camp. No horse will look well if he does not drink freely, and a battery horse cannot be given water too often. In summer the horses should be watered when they come in from exercise, and again before being fed at mid-day. When the weather is hot, I have them all watered at about nine at night; by so doing they do not require so much in the morning, and sweat less at work. In the winter I do not allow them to be watered at the troughs, except on coming in from exercise; each sub-division has two extra buckets which, with the stable ones, are always kept filled; the water thus rises in temperature—a great advantage on cold mornings—and the shy drinkers are helped first.

The rules for feeding are laid down in the "Queen's Regulations," Section XI., par. 17, and following. I do not consider the division of hay the best possible one; I am of opinion that the bulk of the ration should be given at night, it is then that most of the stable injuries occur, and the more hay he gets then, the less likely will a horse be to fight or play with his neighbours, and he will not feel the same inclination to eat his litter. I think one-third of the ration of hay should be given when the horses come in from exercise, and the remainder at night. I allow no hay to be chaffed, the horses eat straw alone quite as well, and the ration of hay is so small that they require every atom of it. Green forage should be given only as a change, it is of little use as food; a proportion of it should be drawn for a week, and then discontinued for a few days; then for another week and so on, as long as it is fresh and not brown-coloured and hard—but never more than half the ration of hay should be exchanged for it. Every horse in my Battery gets half-an-ounce of salt a day; common salt can be bought at the canteen for two shillings and eight pence a hundredweight, so that the cost is small, while the gain, I believe, is great. Rock salt would no doubt be better, but it is much more expensive and wasteful. Salt is given in India as part of the ration, and so it should be in England; it is of the greatest importance in keeping horses in good health. I frequently order a horse extra corn if I think he requires it, but never for more than one in a sub-division at a time, so that the others should not be stinted. The extra corn is given in a special feed

at half-past three; I consider a far greater effect is produced by so doing than if the same amount were given in addition to the ordinary feeds. Where good wheat straw is procurable I have saved it up and exchanged it for corn, but this bargain is only possible with a friendly contractor who supplies good straw, and a jealous eye must be kept on the beds or as much harm as good may result from the exchange. Carrots should always be given in winter, when procurable, at the rate of two pounds for one of corn;[1] they greatly improve the coats and prevent swelled legs and cracked heels. On one occasion when assuming command of a Battery I observed that many of the horses had permanently filled legs and marks of cracked heels; on making enquiry I found that several of them were regularly laid up every winter with these diseases. Knowing the value of carrots in such cases, I got the Contractor to supply them through the whole winter, and the result was that no horse suffered from cracked heels that year. The chaff-bin should be continually inspected; the cutting of chaff involves some trouble, and there is often an insufficient quantity. In my Battery the feeds are mixed in baskets which contain a feed for two horses, they are filled during stable hour, so that it can be seen whether the proper amount of corn, chaff, and salt are given. Stables can hardly be kept too cool, there are generally sufficient means of ensuring a draught of air above the horses' heads, and in summer the half-doors should always be left open.

Regular and sufficient exercise is essential to the well-being of horses, and to ensure it in the winter is a matter of some difficulty. Exercising order is a monotonous pastime, and officers naturally cut it as short as possible, but it should be insisted that it should last for two hours daily. Early exercise is a bad practice; it never lasts long enough, and after it the horses are too often left untouched till the regular stable hour. Exercising order should begin at nine and last till eleven, and horses should never be left more than half-an-hour after coming in, whether from exercise or work.

Remounts should be tenderly treated during their first year; they are, for the most part, bought in the country in soft condition, and, as a rule, are not in good order till a spring has passed over them: and this is true of all horses who lose condition in the autumn or winter; they do not get right till the spring coating is over. Therefore, the greatest care should be taken of horses in October and November, when they are putting on their winter coats: they are far weaker than during the spring change, and should be worked as lightly as is possible. Route marching ought not to be ordered till the middle of November, it is exhausting work, especially to horses in their first year, and it is, in any case, of little practical value. The coats should not be hurried on, the change should be gradual; I never allow brushes to be used while horses are coating excepting for the removal of mud; the skin being in an irritable state, some scurf always exists, but no notice

---

[1] At Woolwich, carrots can only be got in lieu of hay, pound for pound. I am now exchanging two pounds of hay for two of carrots, though I am not very sure the result will be so beneficial as when the pound of corn is given.

need be taken of it, the wisp keeps them quite clean enough. Legs, especially the hind ones, very commonly fill during the coating seasons, and are best treated by hand-rubbing—bandaging, with a number of horses being out of the question; but the ordinary hand-rubbing is a feeble process, and not productive of much benefit; the proper method is to stand over the horses' hocks, and to pass the hands one following the other firmly down the sinews from hock to fetlocks, grasping as much of the legs as possible, and putting plenty of power in the grasp. My orders for evening stables in winter are:—vigorous wisping for a quarter of an hour to warm the horses, and hand-rubbing for the remainder of the time.

On the subject of trimming horses there are many opinions, but when the advantages and objections to the practice have been summed up, the result is generally allowed to be that it is a necessary one. The anti-trimmers point to cart horses as fine examples of the animal in a natural state, but cart horses are by no means exempt from swelled legs and cracked heels, which are supposed to be the diseases encouraged by trimming, and though many Battery horses are coarse bred, many are not, and uniformity must be considered, and can only be maintained by trimming. Moreover, it must be remembered that long hair on the legs involves a great increase of labour on the men in the winter months. Trimming should however be carried out with judgment and within well-defined limits. There are many horses so well bred that their heels never grow hair to any length, and all that requires removing is the growth on the fetlocks. The scissors only should be used in trimming, and not the clipping machine, which shaves much too close. I never allow any horse to be trimmed at all between November and March without my own special order, and this is a most necessary regulation. I always keep a singeing lamp going to take off the "cat-hairs" under the jowls, and the loose tow-like growth which comes to some horses up to, and even above, the knees and hocks. Many horses have a furry growth on their ears, which gives the head a coarse appearance; to remove this, it is only necessary to close the edges of the ears, and cut with the scissors whatever projects beyond them, taking care that the inside is not interfered with; the horse's appearance is improved, and no harm is done. Another vexed question is whether any singeing of the long hair on the bellies should be allowed in the winter; I am of opinion that it should not. If partial singeing is practised, it cannot be done uniformly and neatly; the horse looks patchy and untidy throughout the winter; it is a never-ending business, no sooner is the Battery finished than it has to be begun afresh; and the effects remain visible till far into the summer. And not only do I not believe that horses do any better for it, but I think they do not do as well. Troop stables are cold, and horses want all their natural covering in the winter. If rugs were allowed so that clipping could be carried out, without doubt the advantage would be great, but the partial process I believe to be a mistake.

The state of horses in camp depends almost wholly on the weather, in a continuance of wet it is impossible to prevent them from losing flesh; they will not lie down, they drink little, and are always uncom-

fortable. But the better condition they are in, the less will they feel the discomfort, and the better will they be able to endure it. While the bad weather lasts it is well to take every opportunity of getting them away from the picket lines, if only for half-an-hour, and they should be well exercised before and after watering. When last in camp we applied for hay-nets, and found them invaluable for saving the hay in windy weather; they are really intended for carrying hay on the line of march, and are made in pairs to be slung across a horse; but they are readily adapted to camp use; in most cases they were attached to the head-collars, but some horses preferred picking the hay out of them as they lay on the ground. In wet weather it is a good plan to place the shackles of the heel-ropes above the fetlocks, fastened so, they are kept partly out of the mud, and are less liable to cause sores. In fine weather horses do well on picket lines, the two pounds of corn given in lieu of straw quite compensates for the exposure.

When my Battery is going to march I give the horses a special preparation for a month: they have three-and-a-half hours walking at exercise order, and twice a week for the same time in draught. I seldom trot them, but make them walk out, so as to accustom them to the work that lies before them; the slow horses are urged to walk their utmost, and it is surprising how a slow team, if continually pressed, will improve in pace. I stop the Saturday's bran mash, and give them an hour's exercise on Sundays. Pace on the march depends on the roads and weather; when all circumstances are favourable, and there are no long hills, a Battery of Horse Artillery can cover five miles an hour including halts without distressing the horses, but it is seldom that more than four-and-a-half can be accomplished. In a Field Battery it is not often that all the men can be mounted, so that three-and-a-half miles including halts is good going. The best guide for the regulation of pace is the appearance of the horses, if you know them pretty well you can judge by letting the Battery pass you whether they will bear more trotting or not. I never trot against collar. It is very important to keep the wheel-drivers alive, wheel horses being of heavier frame are not so free as leaders, and are very apt to sit in the breeching; when traces and breechings are tight at the same time you have the worst possible form of draught, and the most favourable combination of circumstances for the production of galls. Some officers change the riding and hand horses; I do not consider it good policy; such change alters the collar pressures to which they are accustomed. Besides, a free hand horse bears himself in a slight curve, and is frequently inclined to jog; therefore if put on the other side not only are the conditions of draught altered, but the driver has a less comfortable ride, and in consequence does not drive so well. In ordinary double harness the outside traces should be slightly longer than those on the inside, because the horses bear themselves on an inward curve, and, in my experience, it is seldom that a pair go equally well on both sides. The fewer halts that are made in reason the better, they waste time, and beyond a certain number are of no benefit; as a general rule, a halt every seven miles is sufficient. I make each Division lead in turn, and the leading team walks as fast as it can;

there is no closing up except at halts. On a march of more than fifteen miles I feed half way, and the horses are watered every day, if possible. I am no advocate of an early start, the horses are better cared for and harnessed, and the men breakfast in comfort if the Battery marches off at half-past eight or nine. Now-a-days there are Coffee Taverns in all towns, and if the men are not hurried, most of them who do not get breakfast in their billets, go to the Taverns, at which a good meal is supplied for about fivepence; men will often go a mile for their breakfast at these taverns, which are of the greatest benefit to soldiers on the march. On a march of more than fifteen miles I carry bread and cheese for the men, which they get at the time the horses are fed.

I have drawn up a set of rules to be observed on the line of march, they are published in the order book before the start is made, and are thoroughly understood by officers and men :—

1. An officer will be detailed for duty each day, he will mount and visit the guard and gun-park by night, and by day on halting days; he will remain at Head-Quarters, or within the range of the billets, and will always be in uniform. On marching days the guard will mount at six p.m., on halting days at two p.m. On marching days the wheeler will take charge of the gun-park half-an-hour after reveillè, as to give the Guard time to get ready for the road. The Advance Guard will be the "New Guard," the Rear Guard the "Old Guard."

2. Officers Commanding Divisions will appoint a time for their Nos. 1 to meet them at Head-Quarters, usually one-hour-and-a-half after arrival in billets; when they have visited their billets they will report to the Commanding Officer and await his orders.

3. Officers are reminded that the greatest attention must be given to the working of the teams and the riding of the gunners; if there is no neglect in this respect, there will be few casualties, and consequently little trouble in billets.

4. Officers Commanding Divisions will pay the billet money daily to the Nos. 1, who will obtain receipts on the prescribed form in the billet books, which will be examined daily. They will also pay the men daily through the Nos. 1.

5. The forage will be given as follows :—Corn : a full feed one hour after arrival in billets, a half feed at six p.m., a full feed in the morning, and a half feed in the nose-bags.

(A full feed should be taken if possible from the starting point).

Hay : one-third when the horses get to their billets, the remainder at six p.m.

Water : one third of a bucket on arrival in billets, one bucket after the men have finished their dinners, and before the first feed of corn; one bucket before the six o'clock feed, half a bucket in the morning.

It is to be particularly impressed on the men that the condition of their horses will depend on the exact observance of these directions,

and that any deviation from them will be considered, and treated, as neglect of duty. For exceptional cases, special orders will be given.

6. The girths are not to be slackened when the horses arrive in billets, and no saddle or pad is to be removed until leave is given by an officer. The rest of the harness and appointments will be taken off on arrival in billets.

7. Nothing is to be carried in the camp kettles, or elsewhere, which is not according to regulation.

8. The men on the carriages will always dismount on coming to an ascent, but they will be carried on the flat, and on any descent which is not steep. Wagons will accompany their sub-divisions.

9. Non-commissioned officers and men proceeding to or from their billets are to walk their horses; they are to be told daily what time they are to parade.

10. Every man who accompanies the Battery is to be properly dressed. Men walking about in the towns will be clean and properly dressed.

11. The hour for marching will be ordered daily; as a rule it will be nine o'clock.

12. The ammunition and store wagon will be packed as follows, and nothing else will be carried:—the tools belonging to the Farrier, Collar-Maker and Wheeler, material for repair, soap, dubbing and oil, Sergeant-Major's box, valises belonging to the men on the axletree seats, to those on the wagon, and to the trumpeters; the officers' baggage.

(I do not take the Quarter-Master Sergeant on the march. I use the Trumpeters as Orderlies, and carry their valises to relieve their horses.)

13. The Farrier and senior Collar-Maker will attend at Head Quarters two-and-a-half hours after marching in, about which time the Commanding Officer will receive the reports from the Subaltern Officers. The Shoeing-Smiths of each Division will accompany the Subaltern Officer.

(On receiving the reports from the officers, I visit all billets where there are casualties, and when I have seen them, any horses who may lie in my way. I do not attempt to visit the whole Battery, nor do I think it necessary to do so.)

14. Prisoners will be seen at the first halt.

15. Men will be in the billets by a quarter to ten. Any complaint about billets must be made before "First Post." None made after that time will be entertained.

16. The Wheeler and junior Collar-Maker will remain in the gun park, relieving each other for dinner, until the limber gunners arrive

to clean the guns and carriages. The Wheeler will examine the carriages, and will be responsible that they and the guns are cleaned, and that the wheels are kept greased: he will see that the gun park is squared up before the limber gunners leave, and one of them will remain with him in the gun park till the Guard mounts.

17. For information as to Route-marching and Billeting, *see* "Standing Orders," page 37.

When furnished with the billets the Non-Commissioned officer in command should ascertain the central point, and billet a half-battery on each side of it. He should procure a list of the Guard, and billet each man of it where there are men available for looking after his horse. Limber gunners should be billeted near the gun park.

18. The Trumpeter will sound as follows, when the Battery marches at nine:—

"Reveillè" at six
"Boot and Saddle" at eight.
"Parade" at half-past eight.
"First Post" at half-past nine.
"Last Post" at ten.

It will be gathered from the foregoing remarks that there is no royal road to a system of good stable management; it must be built up by patient and constant attention to a hundred details, and in the degree of attention to, or disregard of, these details lies the difference between horses in good condition and the reverse. As with other systems in good-going order there must be a strong motive power, which in this one can only be supplied by the eye and example of the Commanding Officer. And it may be asserted with confidence, that a Battery of which the horses are in good condition will not be found wanting in other respects.

ACCOUNT

OF A

VISIT TO THE SPANISH GUN AND SMALL-ARMS FACTORIES AT TRUBIA AND OVIEDO

IN MAY, 1884,

WITH A

DESCRIPTION OF THE NEW ORDOÑEZ R.B.L. GUN OF 15^{cm} (5·9-IN.), TOGETHER WITH A TABLE COMPARING THE PROPERTIES OF THE LATTER WITH THOSE OF CORRESPONDING GUNS IN THE BRITISH SERVICE.

BY

CAPTAIN J. C. DALTON, R.A.,

(D.-A.-A. AND Q.-M.-G., GIBRALTAR).

ON my return overland to England on leave this year I passed through the two most beautiful provinces in Spain, viz., Galicia and Asturias, having obtained permission from the Spanish Government to visit the gun and small-arms factories at Trubia and Oviedo.

Travelling in these provinces, though still slow and in parts very rough, has been much facilitated of late by the introduction of railways, and for the benefit of those who may be desirous of visiting this most interesting part of Spain, a map is appended which shows roughly the positions of the principal towns and the main railway lines with the roads connecting them. It will be seen from this that a line now traverses the provinces of Galicia and Leon from La Coruña, passing by Leon and Palencia to Venta de Baños, where it joins the main line from Madrid to France. From Leon a branch line goes off in a northerly direction to Oviedo, *viâ* Busdongo, whence it continues to the seaport of Gijon; it follows generally the magnificent coach road between Leon and Oviedo. A branch line runs from Oviedo to Trubia. This line from Leon is one of the most remarkable in Spain, and, one might almost add, in Europe. Apparently insurmountable engineering difficulties have been overcome, the whole country being one vast system of mountains, and both from the railway carriage or from the mail coach one sees along the entire route sheer descents fearful to behold, with mountain torrents rushing madly along at the foot of them, and the curves, inclines, and tunnels are, as may be imagined, quite out of the common. Now that Trubia is connected with Madrid by railway, it has been provided with the last essential to make it a perfect situation for an arsenal. The district all round is rich in

minerals of every kind, including coal and iron. A fine river, the Nalon, flows past the factory, and strong water-power is readily obtained. A good seaport, Gijon, is close at hand, and from it ships and steamers ply in all directions. It and the town of Oviedo, the Capital of the Asturias, a few miles off, supply all that is requisite for the little colony at Trubia. The Nalon is a fine salmon river, and all the streams about, and their name is Legion, abound in trout. The climate is severe in winter but delightful in summer, though rather rainy. The country is wonderfully fertile, there being beautiful pasture land and excellent meat and dairy produce, besides vegetables of all kinds.

The Gun Factory at Trubia.

I visited this factory on the 29th of May by train from Oviedo. The entrance to the Arsenal is not two minutes' walk from the station, and there is a capital inn adjoining the factory. On entering the latter, I was received by Major Pompeyo Yzquierdo of the Spanish Artillery, who is second in charge, but who was acting as Director in the absence of Colonel de Lasala, in Madrid. As will always be found in Spain, the Artillery Officers were unwearied in their efforts to show the utmost kindness and hospitality to a brother Gunner, and Major Yzquierdo and Captains Cubillo and Ferrer accompanied me over the Arsenal, explaining all the different processes and latest machinery, Fortunately, at the moment I arrived experiments were going on with the new Ordoñez gun, which I was anxious to see, so I proceeded to the proof-butts, where I saw experiments being made to take the pressures in the bore with a Rodman Crusher Gauge. These were, I believe, satisfactory.

The factory occupies a large tract of ground, and is being improved and added to at the present time. Like all institutions of this kind in Spain, under the management of the Artillery, the utmost is got out of the place that is possible with the amount of money allowed, and if more funds were forthcoming great perfection would be attained, because the Officers in charge are invariably highly educated and scientific, being thoroughly capable of applying their talents not only theoretically but practically. The Trubia factory accomplishes a large amount of valuable work annually, and I saw a long row of modern rifled guns, all apparently of the best workmanship and finish, which I was told had been turned out during the past year and were awaiting removal. At present there are no appliances for making steel on a large scale, and all that I saw done in that line was the manufacture of steel projectiles. No work in bronze is done here, that being all done in the Gun Factory at Seville. The steam-engines and machinery are principally English, American, and German, though there are several made at the factory itself. The Staff is entirely found by the Artillery, the workmen being civilians. In Spain, the Artillery Officers in charge of factories plan and carry out all work connected with these factories themselves, even to such details as building, roofing, &c., the plans and designs being worked out mathematically

by them, and then submitted to the governing body of Artillery Officers at Madrid, by whom they are finally approved. It would be quite unnecessary to describe the workshops, because they are similar to those of other factories, and the general system of carrying on the work similar to ours. A huge water-wheel was being fixed outside a new shed in course of preparation, so that the available water-power may be utilized. Amongst other work done at the factory are some handsome bas-reliefs and busts, &c., specimens of which are on view in the model-room of the Arsenal. Amongst the busts are those of the two heroes of the "Dos de Mayo": the Artillery Officers Daoiz and Velarde, whose names and memory are immortal in the annals of not only the distinguished Regiment on which they shed such a lustre, but of the Spanish nation generally. The factory possesses a fair library, where most of the leading scientific and military journals are to be seen. The grounds are very pretty and nicely planted out. Unfortunately there is no range to be obtained, owing to the mountainous nature of the country round, so that the guns when proved at the proof-butts have to be sent to Madrid to the "Escuela Central de Tiro," where they are further tested, sighted, &c. I saw large quantities of projectiles of all kinds being manufactured, and, amongst others, a number for the old pattern heavy M.L. guns which are mounted in the Phillippine Islands. These were covered with white metal studs, which I noticed were being put in and finished off by hand, a somewhat laborious operation.

The Small-arms Factory at Oviedo.

The works here are in the grounds of an old convent, which has itself been transformed into offices, &c. The Sub-Director, Lieut.-Colonel Emilio Solis of the Artillery, showed me very kindly all over the works which are entirely devoted to turning out Remington rifles, carbines, and bayonets. The machinery is mostly American and the steam-engines English and German. The operations are similar in all respects to those carried on in our small-arm factories. The Remington rifle is still considered by those able to judge as that best suited to the Spanish Service, and it will doubtless continue the arm of the country unless it should be deemed necessary to supersede it by a repeating rifle, which does not at present appear probable. The Sub-Director is just now occupied with an improvement he has proposed by which the rifle will extract its empty cartridge case. At present on opening the breech after firing, the empty cartridge is sufficiently receded to enable it to be removed with the finger and thumb; but, by the new system which is now under trial, the old cartridge will be projected clear on opening the breech to insert the fresh one. By this means the rapidity of fire will be increased to an important degree. The wood of which the stocks are made is of Spanish production, but the barrels are imported as rough steel tubes of small diameter from Germany, which are bored out, fitted, and finished at Oviedo. All the work appears to be very perfectly performed and the materials are of the best quality. The barrels are sighted, tested, and proved on the premises, and the rifles packed in cases and ready for immediate issue to the troops.

DESCRIPTION OF THE 15cm (5·9-INCH) B.L. GUN INVENTED BY MAJOR ORDOÑEZ.—(*See* FIG. 1.)

The *Gun* is of cast-iron, strengthened internally with a double tube of steel.

Length of bore 32·5 calibres—about 16 feet.

Weight of gun 6300 kg. or 6·2 tons, of which the steel tubes alone weigh 1·17 ton.

Rifling.—Increasing twist, commencing at the chamber with 1 turn in 50 calibres, and increasing to 1 in 25 at the muzzle.

B.L. System.—Divided screw and modified Broadwell obturator.

Projectiles.—3·5 calibres (20·65 in.) long, provided with a single copper band to take the rifling. The common shell takes a bursting-charge of 5·72 lbs. Weight filled 92·7 lbs.

Charge.—34·1 lbs. of prismatic powder with one channel, made at the Government Powder Works at Murcia. Density 1·69.

Initial Velocity.—With charge 34·1 lbs., steel projectile 110 lbs., I.V. = 1672 f.s.; with charge 34·1 lbs., common shell 92·7 lbs., I.V. = 1804 f.s.

N.B.—In the former case, the density of the charge = 1·69.
" latter " " " = 0·78.

The *Pressures* were 14 to 16 tons on the square inch.

This gun also can fire the service projectiles of 62·5 lbs. belonging to the present R.B.L. gun of 15cm. The I.V. thus obtained = 2165 f.s., or 623 f.s. greater than is now obtained with this gun, which is of wrought-iron.

Carriage.—Iron plate specially designed by Major Ordoñez to give 23° elevation and 6° depression.

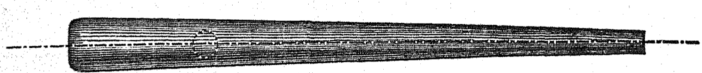
Penetration.—The experiments for penetration took place at Trubia, the target being composed of two plates of wrought-iron, each 5·12 inches thick (similar to the armouring of the Spanish Ironclads *Arapiles* and *Sagunto*), placed in contact and supported on a massive frame with trestles, the target resting against the side of the hillock which serves as the back of the proof-ground. Three rounds were fired at a distance of 65·6 yards from the target, two with a steel—Fig. 2 (*a*)—and one with a hardened cast-iron projectile. On the impact of the projectile with the target the first plate was split right up and into two pieces, the second was perforated so completely that the common belief was that if there had been a third plate of the same thickness at the back it would have been penetrated. The steel projectile, which was picked up a few yards from the target, was knocked out of shape, but the point was intact. Fig. 2 (*b*).

The proofs were considered highly satisfactory. That for range gave a distance of over 5½ miles, the elevation being 18° 36′.

The piece has now fired 200 rounds in Trubia, and is to be sent to Madrid to fire 200 more in the Camp of Gunnery at Carabanchel in presence of the Special Artillery Committee, and if the further experiments prove as satisfactory as those hitherto conducted, and it be found that the gun will endure the strain of a prolonged trial, an

important problem will have been solved, and the State will possess a powerful fortress gun at a very small cost, which can be made in any number at the Trubia factory, and Sr. Ordoñez may be congratulated on the successful results of his talents and labours. A very rough drawing is appended, not drawn to scale and solely from

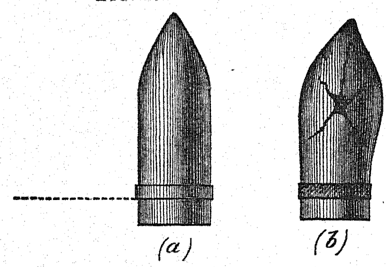
FIG. 1.



Exterior view of Ordoñez Gun (not to scale).

FIG. 2.

Copper Band ... ...



(a) Steel projectile, 20·65 inches long, before firing.
(b) Do do after penetration.
(Not to scale—drawn from memory.)

memory, to give an idea of the shape of the gun, and of the appearance of the steel projectile before and after firing at the shield.

The following table has been drawn up to show the properties and performances of this gun in comparison with those in our Service most resembling it in weight of metal and projectiles:—

GUNS.	Weight.	Charge, Battering.	Projectile.	Ballistic Effects. With Charge. Weight.	Powder.	Weight of Projectile.	Muzzle Velocity.	Penetration into W.-I. Armour-plate.
Ordoñez.	cwt.	lbs.	lbs. ozs.	lbs.		lbs.	f.s.	inches.
5·9-in. R.B.L. ...	124	$37\frac{1}{2}$	110 0	$37\frac{1}{2}$	Prism.	110	2100	10·24
7-in. R.M.L.	130	30	115 0	30	P.	115	1525	7·2
6·6-in. R.M.L. ...	70	25	97 $12\frac{1}{2}$	25	P.	100	1468	...
Interrupted screw.								
6-in. R.B.L.	80	34	79 0	34	P.	80	1881	8·4
6-in. R.B.L.	81	34	99 0	42	$P.^2$	100	1860	10·1

N.B.—The penetration in the case of the Spanish gun was at 65·6 yards from the muzzle. These figures, however, do not probably represent the total capabilities of the gun in armour-piercing.

The penetrations shown for the English guns are at 1000 yards from the muzzle.

The new Spanish field gun, the Sotomayor 7·85^{cm} (3·09-in.), was also being manufactured in the foundry at Trubia.

A table is appended showing its qualities compared with those of the R.A. Service Field Guns, taken from the latest "Table of Service Ordnance and Ammunition."

COMPARATIVE TABLE OF PROPERTIES OF THE SPANISH SOTOMAYOR GUN AND THE ENGLISH FIELD GUNS.

Name and Calibre.	Metal.	System.	Weight of gun.	Charge.	Projectile. Weight of Common Shell filled.	Projectile. Bursting-charge.	Initial Velocity.	Carriage and Weight without side-arms.
			cwt. qrs. lb.	ozs.	lbs.	ozs.	f.s.	cwt. qrs. lb.
Spanish Sotomayor* 7·85^{cm} (3·09-inch) R.B.L.	Coiled steel	Divided screw	5 2 6	54·6	13·86	8·8	1492·4	Steel, 7 3 17
English 13-pr. R.M.L. 3-inch calibre ...	Wrt.-iron, Steel tube	M.L. Polygroove	8 0 0	50	13	10	1560	Steel, 11 3 0
English 16-pr. R.M.L. 3·6-inch calibre ...	Wrt.-iron Steel tube	M.L. French modified	12 0 0	48	16	18	1355	Wrt.-iron, 12 3 0
English 9-pr. R.M.L. 3-inch calibre ...	Wrt.-iron, Steel tube	M.L. Woolwich	6 0 0	28	9	7·5	1390	Wrt.-iron, 11 3 0

* For other details concerning this gun, see 'Translations' issued with 'Proceedings,' R.A.I., No. 7, Vol. XII.

NOTES ON THE TRANSPORT OF A HEAVY (24^{cm}) GUN OF 14·7 TONS WEIGHT OVER THE MOUNTAINS BY ROAD, WITH AN AVELING-PORTER ROAD ENGINE.

This gun was recently transported by the coach road from Trubia to Busdongo by means of an Aveling-Porter traction engine of 8 h.-p. The road, which is entirely through a mountainous country, is an exceptionally difficult one, as I can personally testify from having recently travelled in the coach over that part of it known as the Puerto de Pajares (Pass of Pajares) between Puente de los Fierros and Busdongo, and where it needed ten mules and one horse to drag the ordinary mail coach up the tremendous hills. The inclines vary between 8 and 23 in 100. The gun was carried on a drug capable of bearing about 19 tons, which was specially adapted to the weight it had to bear, and the detachment accompanying it was composed of picked men and skilled artificers, duly supplied with spare stores and all necessary tools. The weather was stormy, with much rain and snow, and the time of year winter; consequently the trial was costly but especially valuable in the experience acquired by it. The whole journey lasted 19 days, and the locomotive returned to the factory

none the worse. The drag also suffered little or no damage. The gun was mounted on to, and dismounted from, the drug by means of hydraulic jacks, which acted very well. Owing to the bad weather and the large amount of traffic on the road the average day's march was 3 miles going and 10½ returning, and if the traffic had been less the pace, doubtless, could have been increased to 12½ miles a day.

The following remarks made on this journey, and published in the '*Memorial de Artillería*' for May, 1884, may be considered of interest:—

(1.) This locomotive has in every way proved satisfactory as regards its mobility. It can turn in a road five feet wider than its own length.

(2.) Though it weighs over 14½ tons it does not in any way damage the road it runs on, even though the latter be much cut up by rain.

(3.) It only needs 2 engineers and 1 stoker for a long journey.

(4.) By itself it can negotiate inclines of 15 in 100 equally as well as or easier than ordinary wagons, and if the road is in good order it can take a weight of 14½ tons up inclines of 1 in 10.

(5.) When the inclines reach as much as 12 or 15 in 100 the locomotive must then be used as a stationary engine, and drag the weight up by means of a single metal cable, taking the greatest care that the level of the water in the boiler be maintained at the height of the indicator to avoid an explosion.

(6.) If the inclines become more than 15 in the 100 a double cable is used, and the tackle belonging to the locomotive is employed with a horizontal pulley, attached strongly to the axle of the fore-carriage of the drug. By these means the 14·7-ton gun was dragged up to the top of the Tivi Gracia, an incline of 23 in 100. As the metal cables are only about 130 yards long, much time is necessarily lost when they have to be used double.

(7.) In descending, great care has to be taken in applying the brakes and in reversing the steam, carefully watching the chains which act as rudder to the fore part of the carriage, as a break in the chain might be fatal.

(8.) The water which the tender of the locomotive contains is enough for two hours, but it is advisable to be constantly replenishing, especially when on inclines, to avoid accident. Hence, if water is not abundant on the road, sufficient must be carried in casks for one day's consumption.

(9.) The amount of coal required may be calculated at 7·1 lbs. per ton carried per five furlongs passed over.

REMARKS ON REVOLVERS.

BY

MAJOR W. McCLINTOCK, R.A.,

Assistant Superintendent, Royal Small Arms Factory, Enfield Lock.

THERE is perhaps no weapon for which there has been so great a demand of late years as for the revolver. The civilian provides himself with this arm for house defence, while the Military or Naval Officer considers it a necessary part of his equipment. The revolver has also been recently issued on Service to our Cavalry Regiments, to Sergeants of Infantry, and to Non-Commissioned Officers and Drivers of Royal Artillery. The Coastguards carry revolvers, and on board ship the blue jackets are similarly armed. The burglar having added the revolver to his professional tools, it has become necessary to give the Metropolitan Police this weapon also.

Although the revolver has come into such general use, there is probably no weapon which is so little understood, and in the purchase of which the customer is so entirely at the mercy of the gunmaker from whom he buys it. Very few purchasers of revolvers understand the merits of the different types of these pistols which are offered for sale, and a still smaller number have the opportunity of testing the mechanism or the power of the weapons they buy; but there is no arm which should be selected with greater care, as, when required for use, the owner is generally in extreme peril, and the failure of his arm may cost him his life. The revolvers which are offered for sale vary considerably in size and calibre,—from the 6-shot holster pistol with a barrel $7\frac{1}{2}$ inches in length, weighing 2 lb. 7 oz., and having a calibre of 0·45-inch or upwards, to the 7-shot 0·220-inch bore, which weighs 4 oz., and has a barrel $2\frac{1}{4}$ inches long.

In the following table, which compares the powers of the various types of revolvers, only those are considered which have a calibre of 0·40-inch or upwards, the pistols which have a less calibre being considered more as dangerous toys than as weapons. The small revolvers which have calibres of from 0·38-inch to 0·220-inch will no doubt kill a man at a very short range, and when the bullet strikes a vital spot: but for general use they are not to be recommended. There are also some revolvers made which have a greater calibre than 0·45-inch, and some which have cylinders chambered for a larger number of rounds than six (twelve, or a greater number of chambers being sometimes

met with), but these are not recommended, as their weight renders them unhandy.

Useful revolvers may be divided into two classes,—the "holster" and the "belt or pocket" revolver. Under the designation of "*holster revolver*" we may consider all such as weigh 2 lbs. and upwards, having barrels varying in length from 7½ to 5½ inches; while the "*belt or pocket revolver*" should not weigh more than 1 lb. 15 oz., or have a barrel longer than 4½ inches. Anyone who has constantly carried a revolver, either when mounted or on foot, will readily understand the reason for only admitting the small and light pistols into the latter class. The above pistols may be either "single-action" or "double-action" these being the terms given to the nature of the mechanism by which the cylinder is revolved, and the hammer brought to the position of full cock. A "single-action" revolver must have the hammer brought to full cock by the thumb of the right hand, this motion also revolving the cylinder and bringing a fresh chamber opposite the barrel. The "double-action" revolver may be treated in the same way, but also by merely pressing the trigger, its hammer can be raised and the cylinder revolved, and on continuing the pressure the hammer is released and the cartridge exploded. This is termed "firing by trigger action." "Single-action" revolvers are now seldom made, as those having "double-action" mechanism are considered to be more useful weapons.

Cartridges, or empty cartridge cases, are ejected from the cylinder by two different methods:—with "non-extracting pistols" by means of an ejecting rod, or with "extracting pistols" by having the frames jointed, so that on lowering the barrel an extractor withdraws the cases or cartridges from the cylinder. Only two extracting pistols appear in the following table, but probably this mode of extraction will soon be adopted for all sizes of revolver, as a rapid means of removing the empty cases adds much to the efficiency of the arm.

Cheap revolvers may be bought for a few shillings, but they are pretty sure to become unserviceable after having been in use for a very short time. The price at which they are sold renders it quite impossible that anything but the most common materials, and the poorest class of work can enter into their construction, and although they may fire a few rounds with accuracy, they will give way under a more lengthened trial. Even high priced revolvers are frequently found to fail, the usual defects being miss-fires, or the cylinder not revolving on the trigger being pressed on the hammer being brought to full cock.

Supposing the cartridges to be perfect, the miss-fires are caused either by the main spring being too weak, the cap of the cartridge not being brought directly opposite the nose of the hammer as the cylinder is revolved, from the hammer nose being too short, or not clearing the sides of the hole in the frame through which it acts. The hammer being loose on its axis-pin will also cause miss-fires. The failure of the cylinder to revolve is caused by the pawl or lifter being too short, or the ratchet on the cylinder in which the pawl acts being defective. With cheap and badly made revolvers these defects may not be noticed at the time of purchase, but after a little wear the mechanism ceases

to act owing to the various parts of the action being of bad material, or not being properly hardened on their bearing surfaces. For instance: if the tumbler bent is left soft, it will, after being a short time in use, become so worn that when the trigger is pressed the hammer will not be raised, or if the revolver is "single-action" the trigger nose will not remain in the bent of the hammer when the latter is placed at full cock.

Occasionally the failure of the cylinder to revolve is not due to a defect in the pistol, but is owing to the ammunition used. Some revolver cartridges are made up with paper between the metallic case and the powder charge, with the object of preventing the deterioration of the powder from contact with the brass case. When these cartridges are fired the paper lining will often be found to be driven between the front face of the cylinder and the breech end of the barrel, so jamming the action. *No revolver cartridges which contain any paper should ever be used.*

As the ordinary customer cannot be expected to know a good from an inferior revolver, he is recommended to make his purchases from a well known gunmaker, who, for his own credit, will not supply a bad article. Indeed, in order to form an opinion of the workmanship of a revolver, it is necessary to strip it and examine each part with care, and only a gunmaker, or one who has made Small Arms his study, is competent to do this.

It is by no means easy to make good shooting with a revolver without a certain amount of practice, and the heavier the charge fired the greater the difficulty in hitting the object aimed at. No two men will probably shoot alike with the same pistol, even though the range is only 15 or 20 yards: and for this reason, it is most necessary that every one should have his revolver sighted to suit himself. A slight alteration of the fore-sight is all that is necessary, and any gunmaker or armourer-sergeant can alter the sight to suit the shooter. For instance: if your revolver shoots high or low, the fore-sight must be heightened or lowered. If your bullets go to the right or left of the mark, the fore-sight must be set to the right or left respectively. It is most essential that the *exact* point aimed at should be struck—for remember that a bad shot may cost you your life.

Carelessly made cartridges may of course cause the best pistol to shoot wildly, and when the powder charge is so small as 13 or 18 grains, a few grains more or less may throw the bullet up or down, even at a short range; but if the cartridges are obtained from a good maker, and are not allowed to become too old, they will be found to be tolerably uniform in power.

The accuracy of fire in a revolver depends much more on the skill of the firer than on the make of the weapon; for, although the range at which revolvers are required to be used should seldom be more than 15 or 20 yards, even at this short distance the unpractical pistol shot will make very poor shooting.

It is mere folly to provide one's self with a weapon and then not learn how to use it with skill: but it is too often the case that men buy a revolver, and after firing a few rounds from it, put it on one side, and never practice shooting with it afterwards.

No fire-arm requires to be more constantly used than the revolver, as without frequent practice, no one can become an accurate and quick pistol shot; and unless one is able to put every bullet with certainty into a 12-inch target at a range of 20 yards, he should not expect to derive much protection from his revolver, when he has to rely on it to save his life.

The following table merely compares what are considered to be the

TABLE COMPARING THE POWER, &c., OF DIFFERENT TYPES OF REVOLVERS.

No.	Description of Revolver.	Calibre.	Number of chambers.	Weight.	Length of barrel.	Charge. Powder.	Charge. Bullet.	Proportion of weight of powder to weight of bullet.	Muzzle velocity.	Energy at muzzle.	[1] Penetration into deal boards.	Recoil.
		inches.		lbs. ozs.	inches.	grains.	grains.		f.s.	ft. lbs.	inches.	ft. lbs.
1	Colt's United States Cavalry Revolver (single-action)	0·45	6	2 5¾	7½	40 18 13	250 265 225	1 : 6·25 1 : 14·7 1 : 17·3	986 709 614	539·2 295·4 188·2	8 4 2½ to 3½	9·493 5·060 2·709
2	Colt's, Frontier (double-action)	0·44	6	2 7¼	7½	40	200	1 : 5	892	353	4½ to 5½	4·966
3	Colt's (double-action)	0·45	6	2 4½	5½	18 13	265 225	1 : 14·7 1 : 17·3	681 602	272·6 180·9	3½ to 4 2 to 3	4·875 2·719
4	Enfield, extracting (double-action)	0·45	6	2 8	5¾	18 13	265 225	1 : 14·7 1 : 17·3	700 600	288 179·7	3½ to 4 2 to 3	4·66 2·443
5	Webley's extracting, No. 4 pattern (double-acton)	0·45	6	2 4¾	5¾	18 13	265 225	1 : 14·7 1 : 17·3	682 598	273·4 178·4	3½ to 4 2 to 3	4·814 2·640
6	Webley's, No. 5 pattern (double-action)	0·45	6	2 7	5½	18 13	265 225	1 : 14·7 1 : 17·3	648 594	246·8 176·1	3½ 2 to 3	4·094 2·458
7	Webley's Constabulary, No. 1 pattern (double-action)	0·45	6	1 14½	4½	18 13	265 225	1 : 14·7 1 : 17·3	650 586	201·8 171·4	3 to 3½ 2 to 3	4·282 3·055
8	Webley's Bull-dog (double-action)	0·45	5	1 1¼	2½	13	225	1 : 17·3	439	96·2	1½ to 2	3·031

[1] The boards used for testing the penetration were of soft white deal, quite free from knots. The range was 20 yards.

various useful types of revolver, and it is not to be supposed by the reader that similar pistols by other makers are not equally good, or perhaps better than those mentioned; but a study of this table should enable the purchaser to select the class of weapon he requires, as he can learn from it the amount of muzzle velocity, energy, penetration and recoil due to each size of pistol, and charge it fires.

The difficulty experienced in making good shooting with revolvers is largely due to their recoil, and this will readily be understood in reference to the above table. A Martini-Henry rifle which is held firmly against the shoulder, has a recoil of 16·6 ft. lbs., while revolvers which have their recoil controlled by one hand only, have a kick varying from 2·443 to 9·493 ft. lbs., according to their weight and the ammunition they fire. The heavy pull on the trigger, which is experienced with most double-action revolvers when they are fired by trigger-action, is another cause of inaccuracy of fire. When the pistol is cocked before firing, the pull-off may be made as light as required, so that when time admits of doing so, it is advisable to cock before firing.

Revolvers, Nos. 2 and 8, fire only one nature of ammunition; the former having a special cartridge, and the latter taking the Adams' revolver ammunition. The remaining revolvers will take either the Government 0·455 cartridge (18 grains powder, and 265 grains bullet), or the Adams' 0·450 cartridge (13 grains powder, and 225 grains bullet). No. 1 fires also a heavy charge of 40 grains powder and 250 grains bullet. Better shooting will generally be made when the lighter nature of cartridge is used, and no useful result except increased range is gained by the use of the heavier charge.

It is well when buying a revolver to see that the ammunition which it is supposed to take will enter easily into the chambers, and that when loaded the cylinder will revolve freely; as some revolvers which are supposed to take the Government 0·455 cartridge will only take that known as "Mark II." (now obsolete), and will not take the present pattern known as "Mark III."

It may be supposed that owing to its large powder charge the recoil of the Colt's Frontier revolver is excessive, but this is not so. As a matter of fact, and, as shewn in the recoil column in the table, the recoil of this pistol is little more than that of revolvers firing the Government 0·455 cartridge, and on account of the balance of the Frontier pistol, even this slight excess of recoil is not felt by the firer. Increase to the weight of the bullet has more influence on the recoil than an addition to the charge of powder. The recoil of Colt's United States Cavalry revolver (No. 1), when firing its own ammunition, is considerable, but not so great as to be disagreeable. This pistol is a most powerful weapon.

Nothing need be said relating to the form of grip, or as to the balance of the pistol, as each purchaser must suit himself in these particulars.

BATTLE FIELDS

IN THE

LE MANS CAMPAIGN.

BY

CAPTAIN R. F. JOHNSON, R.A.

No. 6.

CONNERRÉ AND THORIGNÉ.

9th January, 1871.

THE German left column on the 9th of January had a running fight along the Nogent-Le-Rotrou main road north-east of Connerré, and an action at Thorigné, a village 2½ miles south-east of the same town.

To visit the ground take train to Sceaux station. From here take the good country road leading south-east across the valley of the Huisne, which, here, is about one mile and a-quarter broad, and is covered with meadows and cultivated fields, divided by banks, hedges, and rails. Just before reaching the bridge (a double one of stone), a country road branches off to the west leading to St. Hilaire: it is that followed by the 22nd Division on the 10th of January.

The left (E.) bank of the Huisne valley is steep and broken. At Sceaux, a ridge running up from the south ends in a high knoll, on the western side of which lies the village (700 inhabitants) on each side of the road. With the commanding knoll and the numerous gable-ends looking northward down the road a fair amount of resistance could have been made to the German advance; but the French preferred to make a stand further south.

Leaving Sceaux, the road descends for about three-quarters of a mile. Standing at the bottom of the hill the farm of Joudry is on your left rear on the ridge running south from the Sceaux knoll, which is followed by the Sceaux-Le Luart road. On the left is Vivier farm, distinguished by a large round tower with a conical roof, and on the right are the gates of the drive to Chateau de la Roche, with one or two small houses near them. In front is a ridge running east and west perpendicularly to the road from the Chateau de la Roche in the Huisne valley to Le Poirier farm on the east, where it is connected with the Sceaux knoll ridge by a low *col.* The length of this ridge, which was occupied by the French troops on the 9th January, is a little over 1000 yards, and the slopes towards Sceaux are fairly open and 800 yards long.

At 9 a.m. (on the 9th of January, 1871), the head of a German column, consisting of five battalions, two squadrons, and twelve guns, with a pioneer company, on issuing from Sceaux is received with a hot fire from the French position. A battalion is deployed on the ridge to the left near Joudry farm, and advances against the enemy's right so as to avoid the low ground in front. It is snowing hard, so that guns cannot be used at all, and the infantry have to pick their way from field to field, doing all the fighting themselves; in consequence, the advance is very slow, but at length Le Poirier is captured,

and the French, turned on the right, let go of the ridge and retire into the farms in rear.

The day was dark and snowy, or else the Germans would have been able to see a very large tract of country, including the whole front of their left column. Stand by the kilomètre stone just south of the crest of the ridge. In front runs the road in a straight line as far as Le Coudray over ground that is open, except for a small tract on each side of the road on the *col,* along which it runs from the ridge behind to that between Vouvray and Le Coudray, which here forms the eastern bank of the Huisne valley. From this *col,* 600 yards in front of you, a side valley full of small enclosures runs down to the Huisne by Chateau de la Roche. On the far edge of the enclosed ground are the farms of Merdereau and Croix de Fer, the latter a collection of buildings on each side of the road, which flank each other, and with a garden wall show a front of nearly 100 yards; forming, in fact, a perfect "locality" for defence, if it were not for the cover afforded by the small enclosures in front.

On the left of the road the ground slopes down to large woods which run parallel to it at a distance of 500 or 600 yards. In these woods, two miles south-west, can be seen the roof of the large Chateau du Luart, and slightly to the right of it, on the side of a long ridge about 4½ miles away, the large village of Dollon (2100 inhabitants), whence the left flanking detachment started for Thorigné on the morning of the 9th January. The view to the right is limited by the crest of the Vouvray-Le Coudray ridge a few hundred yards from the main road, and straight in front by some woods near Le Coudray, but to the left front the horizon is bounded by the left bank of the Dué valley, four miles distant, on which can be seen some of the houses of Thorigné.

The French hold the line Croix de Fer-Merdereau gallantly, but are at length driven back, and then make a fresh stand about the cross-roads 600 yards in rear, resting on the small farm of Les Grouas, and the barns of Les Landes in the valley on their right. The ground is now open.

At 3 p.m. the French take the offensive, and the Germans hold the Croix de Fer-Merdereau line with a fresh battalion, the one which has done all the fighting since 9 a.m. having expended all its ammunition. Again the Germans press forward, but the French lose no ground until at a quarter to four their right is turned by a small column, consisting of one battalion, one squadron, and six guns, which has been connecting the main advance with the flanking detachment at Dollon, and on hearing the fighting along the main road has advanced from Le Luart Chateau along the Vouvray road. The French now give way and finally retire on Connerré.

Le Coudray is a small collection of houses on the side of a short, deep, narrow valley running down to the Huisne, which is crossed by the road on a short, high embankment, approached on each side by a steep hill about 200 yards long. There is wood on the left of the road and also on the Connerré side of the Coudray ravine.

The road again dips slightly before reaching Duneau but rises again to its eastern cottages, whence it slopes gradually down in a straight line towards Connerré, finally entering that town by a steepish hill. Duneau (700 inhabitants) lies high up on the bank of the Huisne valley in the midst of gardens and small enclosures.

In the dark, half a battalion of Germans follow the retreating enemy, but are soon stopped by a superior force; and the battalion, which turned the French at Les Landes, advancing along the left of the road has a bayonet encounter, in which it is to a certain extent successful. All the ground southward is, however, full of French troops, and the Germans being fatigued draw off and await the light of the next morning.

Just beyond the dip north of Duneau take the good but narrow country road to the left leading to Thorigné. About a quarter of the way down the hill above Le Croset, in the valley of the Longuève brook, a capital point of view can be attained, just on the right of the road in the corner of a large field. On your left, when facing in the direction you have followed along the road, two miles off, is Le Luart Chateau, on your left front on the other side of the Longuève brook the end of the Dollon ridge which forms the left bank of its valley and to the south the right of that of the small river Dué. This latter valley, running up from the south-east, turns in a more westerly direction after receiving the Longuève, and in it on your right can be seen the tower of Connerré. The valley bottom is full of poplar trees and meadows, but its northern bank, particularly towards Connerré, is open and divided into large fields. The left or southern bank is covered with enclosures and timber and crowned with woods, which are the outskirts of the much-wooded and enclosed country north of Ardenay you passed through yesterday on the way from Pont de Gesnes.

Le Crozet (or Croset) is a small row of houses close down to the Longuève brook. This is crossed by a stone bridge, beyond which the road rises over a low spur, that was covered in 1871 by copses of firwood. Half-a-mile beyond the bridge the junction of the Le Luart and Dollon roads is reached. Turn to the right to the village of Thorigné.

The village (1700 inhabitants) lies on each side of the road and stretches from the Dué to nearly the top of the southern bank of the valley. Its first houses are quite on the side of the stream and commanded from the opposite bank, but beyond them is a gap of marshy meadow, and beyond this a considerable front of buildings looking on the approach of the Dollon road. The orchards to the left or south-east, *i.e.*, all along one side of the village are not very enclosed, and the road through it continually breaking off from the straight line affords many opportunities of sweeping the street with fire, so that it cannot be said to be unfavourable for defence, particularly when the weather prevents the use of artillery. The railway did not exist in 1871.

The flanking detachment of the left German column consisting of 3 battalions, 12 squadrons, and 12 guns advancing from Dollon, found Thorigné occupied and also Le Croset. One battalion advanced to the last place, and two battalions carried the village after a very short combat at 3 p.m. An attempt was made to push on down the valley westward, but was soon given up, the French being found in too great force.

Le Mans can be regained by rail from Thorigné *viâ* Connerré Junction. The walk from Sceaux station to Thorigné by Duneau is about eleven miles.

(To be continued.)

A DISTINGUISHED GUNNER.

BY

CAPTAIN R. H. MURDOCH, R.A.,

Assistant Superintendent, R.A. Records.

Two popular fallacies are current in the Royal Artillery :—

(1.) That its reputation as a scientific Arm culminated with the enormous developement in *modern* times of costly, elaborate, and intricate ordnance, matériel, and munitions of war—demanding close application of years to theoretical and practical Artillery on a scale which dwarfs all pre-Crimean history, and bringing into play faculties and qualifications unknown to other Arms.

(2.) The other, that the relatively higher education of the Artillery *Officer* has been an indispensable factor in this distinguishing characteristic.

Unquestionably there are elements of truth in each, or both propositions; but the facts of regimental history prove abundantly that so far back as the first years of the eighteenth century permanence was given to the "Artillery Train," as a *Corps d'Armée*, for the express reasons of the higher and more varied qualifications demanded of and attributed to the Artillery Officer, rendering the former temporary "Trains" (which had obtained since the time of Henry VIII.) an impossibility; provision being also made for the Ordnance Officer going through long and extensive instruction, at home and on the continent, in the sciences and arts connected with the manufacture and manipulation of Artillery and matériel. Nor have scientific qualifications been confined to the *Officer;* but the very nature of the higher avocations has developed in the *body corporate* a scientific tendency, and acquired for the Royal Artillery its right of being ranked—not only as a Corps of scientific Officers, but as a *scientific Corps.*

Since the early years of the present century there have been developed several remarkably distinguished scientists in the Royal Artillery, in all ranks, to whom the scientific world is under deep and lasting obligations; and not only has the Royal Artillery produced a President of the Royal Society—in the person of General Sir Edward Sabine, the father of magnetic discoveries—but a host of lesser giants in the arts, literature, and poetry, including the names of a Borgard, Eardley-Wilmot (co-founder of the Artillery Institution), Sir A. Lefroy,

Cleaveland, the Köehlers, Anderson (for forty years the confidential collaborateur of Faraday in possibly the most profound investigations ever undertaken by man), William Cobbett,[1] M.P. (ex-Sergeant of Artillery), Sir Thos. Bloomfield, Robert Murdoch, *late* Master Gunner (writer on Artillery and versatile inventor), Captain Robertson (the Addison of Artillery literature) the Mackinlays—one of whom was the inventor of the process of firing guns by electricity, the examination of the interior of rifled ordnance by impressions in gutta-percha, and of the apparatus for photographing guns in the act of firing—Bolton, the father of modern marine signalling; not to mention the Campbells, Grahams, Ritchie, McKeown, Bell, Sims Reeves, and Captain Forbes (father of the General Manager of the South-Eastern Railway).

One of the most remarkable, as having had no adventitious aids, and who never rose above the grade of Gunner and Driver, was

William Sturgeon,[2] Senior.

His regimental record is brief, but presents the man to us vividly, as if alive in the flesh, and one cannot do better than transcribe its terse phraseology:—

Rank & Name.		Enlistment.					Born.		Trade.	Read and Write.	Description.
		Age.	Height, &c.	Date.	Place.	By whom.	Parish.	County.			
Gunner and Driver.	William Sturgeon.	21 years.	5 feet 8½ inches. Chest, 35 inches.	23 April, 1805.	Hull.	Capt. Desbrisay.	Whittington.	Westmoreland.	Cordwainer (Bootmaker).	Yes.	Hair—Brown. Eyes—Grey. Complexion—Fresh.
Discharged at Woolwich, to pension of 1s. a-day, 1st October, 1820.											
Died in Manchester District, 18th December, 1850.											

Like William Cobbett, Sturgeon's barrack-room leisure was rigidly divided between his trade and self-culture; but whereas Cobbett took to writing his French and English grammars, and to stump-oratory in

[1] I have yet to investigate the accuracy of the tradition which connects him with R.A.

Major Hime writes:—"Cobbett was never in R.A. He went to Chatham to enlist in the Marines, and enlisted *by mistake* in the Infantry. His connexion with the Artillery consisted in his marrying the daughter of a Sergeant-Major R.A."

[2] There was another William Sturgeon who enlisted at the same time, and bore the soubriquet of "Fighting Billy," because of his having been present in more battles in the Peninsula (yet without medal or clasp) than any other man in the ranks.

the barrack-yard, Sturgeon's whole soul was engrossed in the construction of Artillery models and electrical toys. The writer has conversed with several "Old boys" who, when "boys," used to swarm on the Barrack-field to get shocks from Sturgeon's kite, and to witness the discharges from an iron key attached to its string—a silk handkerchief being also affixed to the handle of the key, to insulate the operator: one of these, who prides himself on the honour of carrying the kite through the barracks to the "Seven Sisters," on Woolwich Common, being Mr. Gant, the chemist, of Artillery Place.

The soldier's life was then more monotonous and less arduous than now; and there not being any meal after dinner, many unbroken hours of leisure were at the command of the soldier—for good or evil. "Out lights" was sounded at 8 o'clock in winter, and 8.30 p.m. in summer; but with the aid of a rush-light, and covering the windows with blankets secured by forks, Sturgeon was in the habit frequently of preferring his studies to sleep—the mess conniving at his breach of the regulations in consideration of his geniality and occasional odd "jobs to their boots."

On being discharged, in October, 1820, William Sturgeon (who was then married to his first wife, who died at Woolwich childless) followed his trade of bootmaker in a shop which he opened in Artillery Place—now in occupation of Mr. Cattermole—supplementing his income by lectures to Officers' families, schools, &c., on Electricity and Magnetism, and by articles to the *London Philosophical Magazine*. In 1822, he opened the "Woolwich Literary Society"—composed of himself; Marsh, the Arsenal chemist and discoverer of the "arsenic test;" the Woolwich French-Master; and Mr. Gant (Senior), the chemist: in 1824 his contributions to physical research in the *Philosophical Magazine* had procured for him such extensive repute as a scientist that he was enrolled on the permanent staff of that journal, (in which year four masterly articles appeared from his pen); and soon afterwards was conferred upon him the appointment of "Lecturer in Science and Philosophy" at the Royal Military College of Addiscombe.

The *Athenæum* of December, 1850, in commenting upon his death, which took place on 18th of that month, has outlined his subsequent history, and his inventions, &c., as follows:—

"We have the melancholy task of recording the death of Mr. William Sturgeon, which took place on Sunday week at Manchester, where he had for some years filled the office of Lecturer of Science to the Royal Victoria Gallery of Practical Science.

"He was born at Whittington, in the county of Lancaster, in the year 1783, and was apprenticed by his parents to a shoemaker. In 1802, he entered the Westmoreland Militia, and two years later he enlisted as a private soldier in the Royal Artillery. While in this corps he devoted his leisure to scientific studies, and appears to have made himself familiar with all the great facts of electricity and magnetism which were then opening to the world. Ærsted had recently made his great discovery, which resulted in the establishment of the new science of electro-magnetism, at this period engaging the attention of Faraday, Herschel, Arago, Ampere, and others. Mr. Sturgeon entered on the enquiry, and made himself known to the scientific world of the metropolis by his modification of Ampere's

rotary cylinders, employed for showing how two electrified masses have tendency to circulate about each other.

"In 1824, Mr. Sturgeon began to give the fruits of his investigations to the public. In that year no fewer than four papers of great merit appeared from his pen, on the subjects of electro and thermo-electricity, in the pages of the *London Philosophical Magazine*.

"In 1825, he published in the *Transactions of the Society of Arts* the description of a complete set of novel electro-magnetic apparatus. The great merit of this apparatus consisted in the improved adaptation of the magnets, batteries, &c., to one another; by means of which Mr. Sturgeon was enabled to perform, with a Voltaic battery of the size of a pint pot, experiments which had previously required the use of a cumbrous and costly battery. The Society of Arts testified their sense of the importance of this contribution by awarding to its author their large silver medal, with a purse of thirty guineas.

"About this time Mr. Sturgeon made his great discovery of the (soft iron) *electro-magnet;* and having observed the high degree of polarity acquired by a straight bar of iron on making a current of electricity to circulate around it, as well as the suddenness with which the direction of polarity could be reversed by changing the direction of the current, he proceeded to construct electro-magnets on the same principle, but bent into the form of a horse-shoe, so that the poles on being brought near one another could concentrate their action on any given object. This soft iron electro-magnet has entered in the structure of every form of electric telegraph, and it may be regarded as the most important addition made by any experimentalist to the science of magnetism.

"We find Mr. Sturgeon in 1830 publishing a pamphlet entitled 'Experimental Researches in Electro-Magnetism, Galvanism, &c.,' comprising an extensive series of original experiments. In this work he first pointed out the superior effects to be derived from the use of amalgamated plates of rolled zinc in the Voltaic battery, instead of the unprepared cast-zinc then in general use. He prepared his plates by dipping them first into a dilute solution of acid, to cleanse their surfaces, and afterwards plunging them into mercury. He showed that plates prepared in this way do not effervesce in dilute sulphuric acid as the unprepared plates do, and, in consequence require to be much less frequently renewed than the latter; whilst, at the same time, the electric current produced is much more intense and constant."

[It is a remarkable fact that no further improvement has been effected in the preparation of the positive plates of the galvanic apparatus, and that Mr. Sturgeon's amalgamated zinc plates are at the present day employed in every form of improved battery, whether patented or not.—*R.H.M.*]

"In 1836, Mr. Sturgeon communicated a paper to the Royal Society, which contains the description of a perfectly original magnetic electrical machine, in which a most ingenious contrivance was adopted for uniting the reciprocating electric currents developed, so as to give them one uniform direction. By this contrivance Mr. Sturgeon succeeded in producing all the effects due to ordinary Voltaic currents by means of the action of magnets on rotating coils of wire. In the same year, the great industry of Mr. Sturgeon was rewarded by two other important inventions. The first of these was that of the electro-magnetic coil machine, an instrument devised for the purpose of giving a succession of electric shocks in medical treatment, and which has been generally preferred by medical men to all others intended for similar purposes. The other was an electro-magnetic engine for giving motion to machinery.

"Mr. Sturgeon filled the Chair of Experimental Philosophy in the Honourable East India Company's Military Academy at Addiscombe for some years, with great

credit to himself. On a recent occasion, difficulties having fallen upon this able experimentalist in the decline of life, Government, on the representation of some scientific friends, advanced him the sum of £200, and in 1849 awarded him the small pension of £50 per annum, which he enjoyed for only one year."

In August, 1849, a Gunner Quinnay, of the R.A., was killed by lightning while on duty as one of the sentries around the Band when playing in front of the R.A. barracks, and the account furnished by Sergeant Peter McKinlay of the newly-formed R.A. Institution (who himself afterwards obtained public distinction in magnetic appliances), led to Sturgeon's definition of vertical polarity of steel in his work of 1850, on '*Lightning and Lightning-Conductors.*' [The gunner's forage-cap, bayonet, and scabbard are now in the glass case of the R.A. Institution, but without name or date, which the present article may sufficiently identify.] The following is a copy of Sturgeon's original reply:—

"PRESTWICH, NEAR MANCHESTER,
"*August 18th, 1849.*

"DEAR SIR,

"Accept my best thanks for the obliging manner in which you have favoured me with the particulars respecting the death of Gunner Quinnay by lightning. Your description is excellent, and easy to be understood. If I remember right, there is a channel with gratings, parallel to the barracks, which runs the whole length of the parade, for carrying off the water into a common sewer. If I am right, I should like to know if Quinnay was standing near it when he fell. My object for making these inquiries is to place every particular of this circumstance on record, in a work, now in the press, on '*Lightning and Lightning-Conductors.*' The fusion of the bayonet at the points where the lightning entered and where it quitted it are in correspondence with the usual effects of electrical discharges through insulated pieces of metal.

"The magnetic polarity of the bayonet was in consequence of its vertical position at the time the lightning shook it. It is possible, I think, that you will find all bayonets, and swords also, magnetic. You can easily try a few, keeping their points downwards when applied to the compass needle.

"I am, dear Sir,

"Yours truly,

"W. STURGEON."

"*Sergt. P. McKinlay,*
"*Royal Artillery Institution.*"

The last years of this remarkable gunner were embittered by a public controversy, in which he indiscreetly engaged with Mr. (afterwards Sir) Snow Harris, a wealthy and educated cultivator of science. This unhappy controversy was waged in the columns of the "*Annals of Electricity*"—a work which was edited during many years by Mr. Sturgeon, the volumes of which were supplied to the Artillery Library at Woolwich. William Sturgeon died, while engaged in collecting and publishing his works, at the age of 67.

A FRENCH METHOD OF ESTIMATING DISTANCES.

(*From "Nature."*)

DRAW one or more silhouettes of standing or kneeling men upon a card—the standing ones 25^{mm} in height and the kneeling ones 16^{mm}. If you are an artist and have the means at disposal, instead of simply blackening the figures, you may paint both surfaces with the colours that are peculiar to the different uniforms of the enemy, but care must be taken not to lay the colours on too thin. Now cut the figures out with care, leaving sufficient paper attached to their bases to allow the instrument to be held between the thumb and first finger.

The apparatus being constructed, it only remains to use it. At 200 metres distance station one or more men, and, where you are standing, allow an assistant to hold the instrument at the height you direct him to. Now proceed to a distance of exactly four paces, of 0·75 metres each, from your figures, and ascertain whether their general aspect, as regards height and width, corresponds to that of the men stationed 200 metres off. If the resemblance is perfect, you are in possession of one of the simplest and most portable of telemeters; if it is not, you will have to begin all over again. You may renew the operation by placing your men at 300 metres, and taking six paces instead of four (Fig. 1).

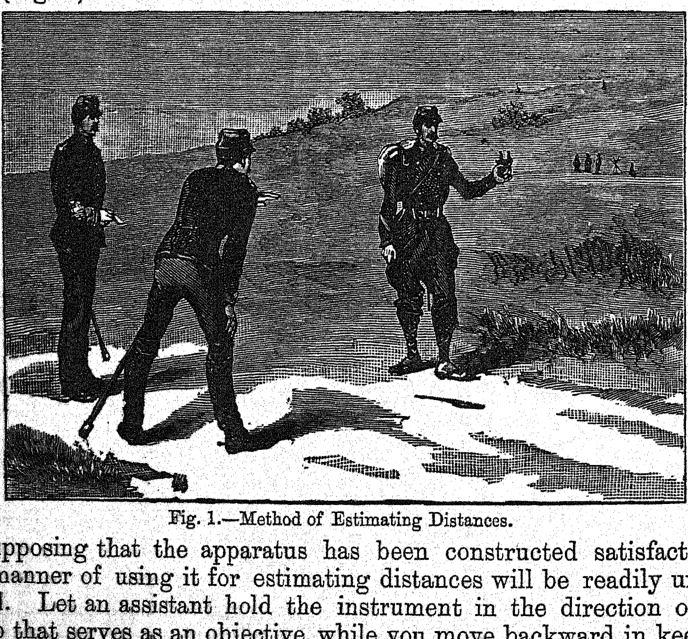


Fig. 1.—Method of Estimating Distances.

Supposing that the apparatus has been constructed satisfactorily, the manner of using it for estimating distances will be readily understood. Let an assistant hold the instrument in the direction of the troop that serves as an objective, while you move backward in keeping your eye upon the silhouettes and the objective, and stopping when the figures and men exhibit the same aspect and seem to form part of one and the same group. Then returning to your assistant, you count the number of paces that separated your eye from his hand. Upon

multiplying this number by 50, you will obtain a product that will give you in metres the distance sought.

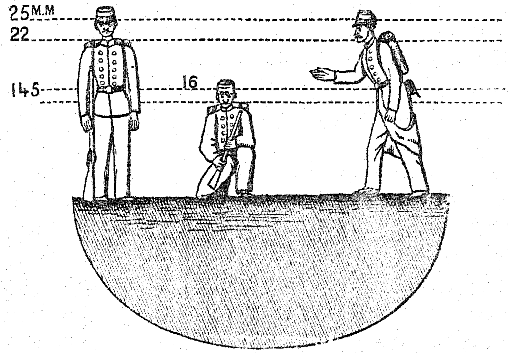


Fig. 2.—Apparatus for Estimating Distances (actual size).

Notwithstanding the wonderful simplicity of the instrument, it is easy to control the accuracy of the principle upon which it is based, first, by reasoning, and then by experiment.

In the similar triangles, ABC and DEC (Fig. 3), we have the ratio:—

$$(a) \qquad x = l\frac{H}{h}$$

H and h being constants, l will have to vary with x, that is to say, with the distance.

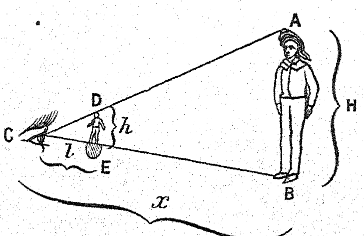


Fig. 3.—Apparatus for Estimating Distances.

The arrangement adopted permits, on holding the instrument away from the eye, of diminishing the difficulty that the latter has of seeing the objective and image simultaneously. Besides, it lessens the trembling of the hand that holds the apparatus, and which would render observation impossible in an ordinary stadium placed at $0{\cdot}6^m$ from the eye.

What is the value of $\frac{H}{h}$? In the majority of proportional base telemeters the distance sought is 50 times greater than the base. Such a ratio is very convenient, since it necessitates a base of only 20^m for a distance of 1^{km}. However, as the observer can scarcely measure the base otherwise than by pacing it off, it has seemed preferable, in order to expedite the operation and avoid a conversion of pace measurements into metre ones, to take a mean pace of $0{\cdot}75^m$ as unity, and to modify the formula so as to at once obtain the distance in metres.

In formula a, on substituting $n \times 0{\cdot}75$ for l, and making $\frac{H}{h} \times 0{\cdot}75 = 50$ (H being equal to 1,665) we shall have $0{\cdot}249^m$ as the value of h.

If, however, greater precision were required in the results, the metre might be preserved as the unity of measurement of the base, the silhouettes be given a height of 33^{mm}, and a cord about 30^{m}, with knots 1^{m}, apart, be employed. But it will be readily understood that this process, although more accurate, is much less practical.

Let us now examine the causes of error, as well as their limits.

The height of a soldier, taken as a base, varies between $1{\cdot}45^{m}$ and $1{\cdot}8^{m}$. As the mean height generally admitted is $1{\cdot}665^{m}$, we should, upon taking this as a basis and operating upon extreme heights, commit an error of about one-thirteenth, more or less, of the distance sought. But if, besides the height, we consider (and it is the case here) the breadth of several men, we see that this dimension has less variation, and that we could not assign to the error a value of more than one-fourteenth. This might, moreover, be sensibly reduced by means of operations repeated upon different subjects.

Another cause of error is due to the manner of doing the pacing, which may vary from $0{\cdot}7^{m}$ to $0{\cdot}8^{m}$ at the most when some little attention is paid to it, or $0{\cdot}05^{m}$, more or less, than the normal pace. But the error committed in this case will represent only one thirty-fifth, more or less, of the distance sought, and this may be thrown entirely out of consideration when regulating firing is concerned. The two errors, upon being added, will, at the worst, never give a deviation of more than one-tenth in the real distance, and we shall admit that such an approximation is sufficiently exact if we reflect upon the gross errors that we should commit in estimating by eye, and upon the great variations in range that occur in the best regulated firing.

Let us add, that with this instrument it is not necessary to see the entire object; if the upper part of a man's body can be seen, it will be sufficient.

In clear weather this process can be applied to distances of 1,000 metres and beyond; but if there is a field-glass at one's disposal, it will be preferable to use it for very long distances. In all cases it is well to light the image as much as possible in the same manner as the men observed. If, for example, these latter were in shadow and the instrument were too brightly lighted, it would be necessary to cut off with the hand or cap the solar rays that were falling thereupon.

It resulted from experiments made at Fort Cagnelot, on the Langre plateau, that, out of thirty measurements, one only could be considered as insufficient, this having given an error of at least one-eighth of the distance. All the rest showed a deviation much less than that which had been fixed on as a limit; and, if a mean of such deviations be sought, it will be found that it was only one twenty-second. The little instrument that we have just described has in nowise the pretension to replace those excellent telemeters that all Infantry corps are provided with; but it offers a sure and convenient means of estimating distances, and we believe that a frequent use of it will quickly familiarize the observer with making such estimates by the unaided eye, and this, it should not be forgotten, will always be the most really practical method on the field of battle.—*La Nature.*

SIMPLE
TELESCOPIC SIGHT FOR FIELD GUNS.

BY

LIEUTENANT H. A. BETHELL, R.A.

The utility of telescopic sights is generally admitted, but none have as yet been issued to the Service. I propose to describe a simple make-shift, by which one of the telescopes supplied to the Battery can be converted into a telescopic sight.

The contrivance consists of a wooden batten resting on the fore and hind sights, and fitted with Vs in which rests a telescope with cross wires.

The following detailed description and drawings will enable the contrivance to be made up by the Battery artificers:—

1. The batten is a piece of well-seasoned wood (old deal is as good as anything) 5′ 8″ × 2″ × 1″. (This refers to the 9-Pr. of 8 cwt.) The fore end is cut into a tongue and bound with brass, and should fit easily between the two muzzle sight-protector blocks. In the lower surface of the tongue is cut a rectangular recess 5-16ths of an inch deep, and into the bottom of this is fitted a brass screw with the head bored and counter-sunk to take the point of the foresight. When in position, the tongue should fit easily between the muzzle blocks, and be supported only by the point of the foresight.

At the rear end of the batten are attached two hard wood wedges, which fit on to the top slopes of the tangent-scale. A small triangular metal slip between them fits into the notch.

The Vs for the telescope are of hard wood, the front one as low as possible; they are fitted as shown in Fig. 5, so that they may be moved sideways for adjustment.

2. *The Telescope.*—If there is any choice, select the one that is straightest and has least shake in the joints. Unscrew the smallest joint: it has the eye-piece at one end and another lens at the other. In front of the latter lens the cross wires are fixed. The lens will be found to be fitted into either a sunk or a projecting socket. A brass ring is turned to fit either into or over this. Four small holes in the ring hold in position the cross wires, which are two blued needles.

They should be close to the glass, and the intersection should be in the centre.

To see if the telescope is centred, place the batten on the sights, the telescope in the Vs, and point it at any object. Now turn the different joints about. If the cross wires continue to bear upon the same point, you can proceed to the final adjustment. For this, lay the gun with the sights carefully on a well-defined distant object, and rasp away the Vs until the cross wires bear on the same point. If the telescope is not centred it must always be used with the joints in one position; to insure this, into each joint a small stud is let in, which fits into a corresponding notch in the screw socket (*see* Fig. 4). This is not necessary for the eye-piece joint. Thus, when the telescope is pulled out and the joints twisted round, each joint will be stopped in a fixed position by the stud. The final adjustment may then be proceeded with as before. The wooden Vs when adjusted are fixed in position by screws.

The cost of making this instrument is in this country (India) about three rupees or five shillings. The batten is carried under the near side of trail, the telescope either by the No. 1 or between the brackets.

Drill.—At the word "load," No. 1 puts up the tangent-scale and pulls out the telescope; No. 4 unstraps the batten, throws the fore-end over to No. 3, and places the other end on the tangent-scale; No. 3 fits the fore-end on to the muzzle-sight; No. 1 places the telescope in the Vs and lays.

Since writing the above I have read a description of Major Scott's telescopic revolving sight. The makeshift I have described above does not attempt to compete with his admirable invention; still it occurs to me that his method of laying on the last point of impact may be applied to my sight.

Thus:—No. 1 gun lays on the target with the telescope; when No. 1 gives "ready" he hands the telescope and batten over to No. 1 of 2, who has also laid with the same deflection; No 1 of 2 places the batten on his sights and looks through the telescope. Say the shot strikes 10 feet right: No. 1 of 2 slides over the deflection-leaf, carrying with it the telescope, to the left till the cross wires bear on the point of impact, and clamps it: this gives the deflection for the rest of the Battery. No. 1 of 2 has only to "trail right" until the cross wires again bear on the bull's eye.

When firing at a position sloping towards the Battery, the elevation can be corrected in the same way; if No. 1 shot is short, No. 1 of 2 raises the tangent-scale till the cross wires bear on the point of impact and elevates the gun: the tangent-scale shows the correct elevation approximately.

EXPERIMENTS

IN

BURSTING OF HEAVY GUNS WITH GUNCOTTON.

BY

LIEUT. F. A. RANDOLPH, R.A.

At the commencement of the present year the Egyptian Government sold a large proportion of their cast-iron, and many of their wrought-iron guns, to a company which purchased them, not as guns, but for the sake of the iron. The cast-iron guns were still in good condition; but the others, chiefly 9-inch and 10-inch R.M.L., had been rendered unserviceable by charges of guncotton placed about two feet from the muzzle of the gun. These experiments were carried out by our Royal Navy in 1882, and, I believe, they have records of them.

After buying these guns, the Company had to transport them to a quay in the harbour of Alexandria, where they could be placed on board ship and taken to Europe. This was simple enough with the lighter guns, but, when they came to the task of moving the heavier natures, they found that there were no stores in Egypt fit for the work. On hearing of their dilemma, I volunteered to attempt to blow them up with guncotton into pieces of a merchantable size, and they accepted my offer.

The whole of the experiments were carried out with 9-ounce slabs of guncotton.

1. On the 15th May I commenced on a cast-iron S.B. of about four tons weight. The gun was dismounted and sunk into a hole in the ground muzzle up. The charge consisted of 3 wet and 1 dry slabs of guncotton, lowered down to the bottom of the bore with one No. 5 high-tension detonator fastened in the dry slab with the wires attached. The gun could not be filled with water as there were no waterproof bags available in which to place the charge, so sand was used instead. On explosion the result was to all appearances *nil*.

2. On the same date, a 10½-inch cast-iron S.B. of 11 tons was experimented upon. The gun was dismounted and sunk in the same way as the former one, and everything was identical with the exception of the amount of the charge, which consisted of 1 dry and 12 wet slabs. However, in spite of this charge, the result remained the same as before, namely, *nil*.

3. On the 27th May, in conjunction with the Navy, we tried again on the S.B. of 4 tons, which had not been damaged by the first explosion. The charge this time was greatly increased so as to ensure success: it consisted of 9 lbs. of guncotton placed inside the gun in a bag, and lowered by a piece of string as far as the trunnions. The detonator was the low-tension one used by the Navy. A ring of guncotton 9 lbs. in weight was then strung and placed round in front of and resting on the trunnions. This also had a low-tension detonator. The two detonators were connected by an insulated wire, and each detonator was connected with the battery, thus completing the circuit. No sand or tamping was used. On explosion the gun burst. The breech was left whole, but the remainder, from the muzzle to a short distance in rear of the trunnions, was broken into small pieces, which flew in every direction, some falling quite 400 yards off.

4. We then experimented upon a 10½-inch cast-iron S.B. of 11 tons (not the one mentioned in No. 2 trial). It was lying on the ground. The charge was 18 lbs. of guncotton, of which two 9-ounce discs were dry. The detonator was low-tension. The charge with the wires attached was tied up in some sacking into an elongated shape like a cartridge, just small enough in diameter to go into the gun, and it was then rammed home to the end of the bore. On explosion, about 4 ft. 6 ins. of the muzzle and a piece of the breech about 1 ton in weight were left whole, and there was one other large piece about half a ton, but the rest was broken into small pieces, the farthest flying about 100 yards. No sand or tamping was used.

5. Our efforts were now brought to bear on a 10-inch R.M.L. gun of 18 tons, of which the number was 2376 and year 1870. The gun was scotched up on its platform. A charge of guncotton had evidently been exploded inside this gun previously, about 2 feet from the muzzle, causing a few small cracks where the explosive had been resting, thus rendering the gun unserviceable. We rammed 24 lbs., wrapped up in the shape of a cartridge, home to the end of the bore, and fired by the battery in connection with a low-tension detonator. There was no tamping used, and the result was *nil*.

6. Another trial was then made on the same R.M.L. gun. Twenty pounds of guncotton was pushed down as far as the trunnion-ring, and two empty 9-inch shells were put just in front of it. A ring of guncotton about 30 lbs. in weight was tied round in front of the trunnions, each disc being in contact with the gun. The two charges were connected in the same way as in No. 3 experiment. From some extra-

ordinary cause the charge inside went off without the other, probably owing to one detonator being more sensitive than the other. The coils appeared to be slightly opened. On completing the circuit again the ring detonated, resulting in leaving a slight mark all the way round the gun, and tightening the coils again.

7. At the beginning of June I tried again by myself. The first gun was the cast-iron one mentioned in No. 2 experiment. A charge of 15 lbs. guncotton was lowered down just below the trunnions. High-tension detonator. The gun broke up into fairly even-sized pieces: the heaviest being about a ton, and no pieces flew more than 30 yards.

8. A similar gun, sunk and charged in the same way as the previous one with 15 lbs. of guncotton, broke in an almost identical manner, although no guncotton had previously been fired in it.

9. Another 10½-inch cast-iron S.B. of 11 tons, mounted on a wooden carriage, was next tried. A charge of 12 lbs. of guncotton was rammed home just beyond the trunnions. The gun cracked all round in the region of the charge, and had one long crack underneath extending half-way to the muzzle.

10. An extra charge of 6 lbs. was rammed home to the same place, the result on explosion being that a large piece (a ton) was blown out underneath, and the rest of the gun was cracked in every direction, and had the appearance of being only held together by the carriage. I believe that afterwards, on dismounting this gun, it did not fall to pieces as I expected that it would.

11. A similar gun of 11 tons, mounted on a wooden carriage, was charged with 17 lbs. of guncotton rammed home a foot beyond the trunnions. On explosion it broke up into fairly even-sized pieces, ranging between a ton and half a ton in weight. The wooden sides of the carriage opened out from the transoms and fell off the platform. A few pieces of the gun flew about 30 yards, but the majority were within 10 yards of where the gun had stood.

12. In the next experiment the details and result were all the same as before. The gun was mounted within ten yards of where the other had been. Everything thus being in our favour we tried how quickly the duties could be done consistent with safety. It took 14½ minutes to do everything between the two explosions.

13. On a cast-iron S.B. of about 4 tons we tried 7½ lbs. of guncotton. The gun was mounted on a wooden carriage. It resulted in bursting and breaking the carriage, but the pieces of the gun were too small, and several of them flew over 100 yards.

14. With the next, which was a similar gun, we used 6 lbs. In this

case and the last the charge was rammed just beyond the trunnions. The gun broke up evenly, all the pieces being within 20 yards of the explosion.

15. Having only 3 lbs. of dry guncotton left from what I had taken out that day I put it in a 32-pr. S.B. on the ground. This charge cracked the gun all round but did not break it.

16. On 15th June, 1884, I broke two cast-iron S.B. guns. Both were 10½-inch of 11 tons mounted on wooden carriages, and the charge used in each instance was 16 lbs. guncotton. The first was the most successful experiment made: the gun broke up, and the farthest piece was only 15 yards from the explosion.

17. With the second, my wire had become very short, and I had to stand behind a Martello tower within 20 yards of the gun. The right trunnion had previously been broken off and the gun spiked. The charge was rammed home to its usual place. Directly after the explosion I saw large pieces flying past me, and some of these pitched quite 200 yards off. At the same time a round shot rolled down the exterior slope, thus showing that the gun must have been loaded. It had probably been disabled during the bombardment of Alexandria.

18. The following experiments were carried out by Lieut. Galloway, R.N., H.M.S. *Invincible,* on four S.B. and one R.M.L. guns, the S.B.s being at Fort Adjemi and the R.M.L. at Fort Meks. They took place on the 25th and 29th August. I was only present at the later date, and am indebted entirely to Lieut. Galloway's kindness in allowing me to take notes from his report of what happened on the 25th, and partially also as regards the trial on the 29th August.

The trials at Adjemi consisted in breaking up four 10½-inch S.B. guns of 11 tons mounted on wooden carriages. The first was charged with 13 lbs. of guncotton, of which 2¼ lbs. were dry and the rest wet. Two naval detonators were used to ensure the detonation of the whole charge. I believe the charge was rammed home. A long piece of the muzzle was left whole after the explosion, and the rest was broken into six pieces, the farthest of which only flew 20 feet. The carriage broke, the sides opening out from the transoms.

19. In the second gun the charge was the same weight, but was placed 6 inches closer to the muzzle. It broke more evenly than in the last case, and there were seven pieces, some of which flew 20 feet.

20. The weight and position of the charge in the third gun were the same as in the previous trial, but as a result the gun only cracked lengthways near the charge.

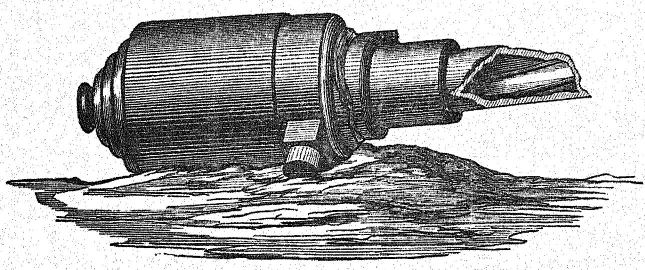
21. Nine pounds more of guncotton were put in the same place in the gun as the last charge, and resulted in bursting the gun; the

whole of the centre was broken into small pieces, but large portions of the breech and muzzle were left unharmed.

22. In order to make certain of the fourth gun breaking, a charge of 14 lbs. 10 ozs. were used. The gun burst in nearly the same way as the previous instances, the pieces flying from 20 to 30 feet to the right and left. No tamping was made use of with any of these four guns.

23. Lieut. Galloway then went to Meks, and tried what could be done with the same 10-inch R.M.L. gun mentioned in No. 5. I omitted to state previously that this gun had been struck by a shell, during the Bombardment of Alexandria, on one of its coils, and although it glanced off the gun must have been weakened by it. Thirty-seven pounds of guncotton, of which $2\frac{1}{4}$ pounds were dry, were rammed home. Next to this was placed 35 pounds of powder, then came two wads, one dry and the other wet, and outside everything were two 9-inch shells. The wires were made fast to a detonator in the guncotton. Nine-inch shells were used in this as well as in the previous trial in order to allow the wires to pass out over them. The result of the explosion was to blow about 2 feet 6 inches off the muzzle. There were also three longitudinal cracks in the trunnion-piece, and one slight one through the right trunnion. All the coils seemed slightly shifted and opened out. The A tube appeared to be cracked near the charge.

24. On the 29th August the same gun was experimented upon. The gun had been dismounted, and was lying on the ground. The breech was partially sunk so that the gun was elevated slightly. The vent was underneath. The charge this time was 51 lbs. of guncotton placed in three 9-inch empty cartridges, 17 lbs. in each. The first cartridge was rammed home, and contained a dry disc and two detonators in the front part. The second contained four dry discs and two detonators,



ROUGH DIAGRAM OF 10″ R.M.L. GUN, AFTER THE LAST EXPERIMENT ON 29TH AUGUST, 1884. NO. 2376; YEAR 1870.

and the third had a dry disc and two detonators in rear. The wires were made fast to a detonator in the centre cartridge. A 9-inch common shell with the top broken off was filled with case shot to increase the weight, and then rammed home. Then came about 18 lbs. of fine grain powder, and outside everything was placed a 10-inch

chilled shot, the end of which just reached the muzzle. A 10-inch shot was used in this instance, as it was found that, owing to the enlargement of the bore from previous explosions, there was room enough for the wires to pass over it. The explosion caused pieces of the gun to fly great distances, some of them going from two to three hundred yards. On going up to the gun we found that it had turned round to the left, at right angles to its previous position, and had broken as in the accompanying diagram. The crack in the right trunnion was not enlarged, but the A tube was cracked from the muzzle to nearly the end of the bore, and the whole tube was indented especially where the guncotton had rested. All the coils in rear appeared to be slightly forced out, but they were not broken. It thus seems that in order to break up this or other wrought-iron guns entirely, a stronger explosive than guncotton would have to be used: say, blasting gelatine.

With regard to the detonators, I found that the low-tension ones used by the Navy, with wires attached, were much more convenient to use than our No. 5 detonator, owing to the difficulty in ours of bending the wire in any required direction after they are fixed in the detonator.

In breaking up cast-iron guns, care must be taken that no one is within 150 yards of the explosion, unless they are under cover behind a moderately thick wall, in which case, I consider 40 yards to be a perfectly safe distance.

To ensure breaking a cast-iron gun, I think that the charge should consist of $1\frac{1}{2}$ lbs. of guncotton per ton of gun, and that the front of the charge should be 6 inches behind the trunnions. If tamping were used $1\frac{1}{4}$ lbs. of guncotton would probably suffice. A ring outside the gun should never be used, as it cannot do nearly as much harm as if the same quantity were placed inside.

PRÉCIS

AND

TRANSLATIONS.

FRANCE.

I.

REVUE MILITAIRE DE L'ETRANGER,

15th February, 1884.

BY

MAJOR J. H. G. BROWNE, R.A.

COMBAT OF THE DIVISION IN ITALY.

. . . .

IN order to give an example of a combat, the Infantry Division[1] has naturally been taken as the unit to be dealt with in theory, because the Division is that fraction of an Army in which are met with, for the first time, the combination of the different Arms, and the resources which are necessary, in order to carry out an action from its commencement to its definite conclusion. Under this idea, by a Ministerial Note of the 30th July last, new instructions have just appeared in Italy, under the title of "*Norme generali per la divisione di fanteria in combattimento.*" These instructions are as yet only provisional, and the Minister at War has directed that they should be applied during great manœuvres, and generally whenever the units comprising the three Arms are called upon to manœuvre.

The instructions under review are divided into several chapters, which treat of the order of march of a Division; of the disposition of the Advanced Guard on meeting the enemy, whether on the offensive or defensive; of the passage from close order into deployment for the attack or defence; and, lastly, for pursuit and retreat.

. . . .

[1] The Infantry Division in the Italian Army comprises 4 Squadrons of Cavalry, 3 Batteries of Artillery, 1 Company of Sappers, and 4 Regiments (3 Battalions each) of Infantry.—*J.H.G.B.*

Duty of the Advanced Guard when the Enemy is Signalled.

Neglecting the hypothesis of an enemy who appears upon one of the flanks of the Column, the two following cases present themselves :—

(*a.*) The enemy is signalled as halted and in position.

(*b.*) The enemy is signalled as advancing against the head of the Column.

(a.) *The enemy is halted and in position.*

Generally the enemy in position is signalled by the reconnoitring Cavalry, who ought to endeavour to drive back the detachments of the enemy's Cavalry, and not to stop until obliged to do so by the Infantry outposts. When this last point is reached, they reconnoitre the front of the position, pushing even beyond the flanks with a view to determining the extent of front, and to estimating the force of the enemy. If, between the enemy and the Division on the march, there exist any important military positions, and especially defiles, which can be occupied by a small force, the reconnoitring Cavalry, accelerating their pace, can make sure of their possession ; a good precaution, especially when the Infantry of the Advanced Guard is near enough to rejoin them speedily.

The Commander of this Cavalry will be careful to inform the Commander of the Advanced Guard promptly of the presence of the enemy and of the result of his reconnaissance. When the reconnoitring Cavalry is repulsed by the opposing Cavalry, the duty of the head of the Advanced Guard is to receive them, and to close the road to the Cavalry in pursuit. In the last case it is the duty of the Commander of the head of the Advanced Guard to supply the Chief of the Advanced Guard with the necessary information indicated in the preceding paragraph.

Whatever may be the issue of the encounter of the two Cavalries, as soon as the enemy is signalled, the head of the Advanced Guard takes the offensive energetically against that part of the enemy's position which appears to be the principal obstacle to the continuation of the march. By this proceeding it is immediately seen if considerable forces are in front, against which it will be necessary to engage the whole of the Advanced Guard, or if there is nothing but a line of unsupported advanced posts, the only object of which is to bring on a premature deployment.

As soon as he is himself informed, the Commander of the Advanced Guard reports to the Divisional Commander the presence of the enemy in force, and its exact position, and at the same time he forwards this information to the Commanders of the lateral Columns. He thus insures unity and agreement of effort in the action which is about to commence : that done, he goes with the Commander of the Battery at the head of the Advanced Guard to take stock of the situation itself.

The presence of considerable forces of the enemy being reported, the Commander of the Advanced Guard orders the Infantry of his

main body to form line of Company Columns in close order, and the Artillery to advance in order to support the action of the head of the Advanced Guard by its fire.

The Commander of the Advanced Guard having recognised the necessity of employing his main body, deploys it, and advances against the enemy's position, driving in the advanced posts. This offensive forward movement ought not to be stopped except by serious resistance.

After this period, and particularly when the enemy brings his Artillery into action, the Infantry of the Advanced Guard will halt their chain of sharpshooters at about 700 metres from the enemy's sharpshooters. The Battery of Artillery will get into position at the same time so as to counteract the hostile Artillery efficiently (at a distance which ought not to exceed 2400 metres) and so as not to be exposed to the fire of the Infantry masses, from which they should keep themselves at a distance of 1200 to 1500 metres. Then begins, for the Advanced Guard, a tentative fight, during which it ought to make a reconnaissance of the front, of the approaches, and of the defensive value of the enemy's position. It ought also to estimate the strength of the forces which occupy the position as well as their dispositions, in order to make a report to the Divisional Commander.

The Advanced Guard will not seriously engage itself except to take possession of a position feebly defended and important, in view of the future development of the action, or to maintain itself there when the enemy tries to dislodge it. In the last case, the Advanced Guard will employ all its troops if necessary, for it must soon be supported by the main body of the Division.

During the Advanced Guard action, the Cavalry operates against the enemy's flanks in order to prevent any sudden attack against the Advanced Guard itself, or against the flanks of the Division. It seizes all favorable opportunities of annoying the enemy by offensive movements; and this *rôle* continues from the time of the deployment of the main body up to the end of the action.

The Enemy marches against the front of the Division.

When the enemy is signalled as advancing against the head of the Division, the *rôle* of the Advanced Guard is nearly the same as that indicated above.

If the Cavalry repulses that of the enemy, the head of the Advanced Guard supports the exploring movement, and advances sufficiently to ascertain whether there is in front a simple reconnoitring detachment, or a formidable column of troops on the march. In the latter case the head of the Advanced Guard is supported by the Cavalry, which directs its efforts especially against the enemy's flanks.

If the exploring Cavalry is driven back, it rallies under the protection of the head of the Advanced Guard. The latter repulses the victorious Cavalry by its fire, and obliges the Infantry of the enemy's Advanced Guard to halt.

In both cases, the Battery of the Advanced Guard supports the operations of the head of the Advanced Guard by rapidly taking up

the position which affords the most extensive field of fire over the ground which the enemy must traverse in order to advance. The main body of the Advanced Guard forms up in mass upon its head, and holds itself ready to deploy if required to do so.

The mission of the Advanced Guard from the moment when the enemy is signalled in position or on the march is very delicate. The Advanced Guard ought, in fact, to meet complicated and sometimes even contradictory requirements. Thus, for example, on the one hand, it is bound not to seriously engage itself, without overpowering reasons, against a superior force capable of inflicting very heavy losses upon it; while, on the other hand, it must avoid allowing itself to be checked by a handful of men, in order to prevent the Division, when insufficiently informed of the motives for checking the march, from frequently and inopportunely taking up mass formations, which would occasion fatigue and loss of time.

The Company of Sappers which marches with the Advanced Guard ought not to be engaged except under absolute necessity. Its mission is to remove the obstacles which present themselves to the march and to the deployment of the Division, to make temporary bridges, to level walls, hedges, &c., and to hamper the enemy's march by breaking up the roadway on ordinary roads or on railroads. During the fight, its business is to put localities into a state of defence by means of abattis, barricades, breastworks, palisades, shelter-trenches, &c. In principle, the Company of Sappers ought not to be employed, except on the most important works, and should be kept together as much as possible, the Corps-Sappers being utilized for ordinary works.

. . . .

At the time when the Advanced Guard has been able to ascertain that the enemy is in force and accepts the combat, the situation of the Division will probably be as follows :—

(*a.*) The Infantry of the Advanced Guard keeps up a desultory action with its chain of skirmishers at short ranges in the first zone of fire (from 700 to 800 metres) from the enemy's Infantry; the rest of the force is placed in the most suitable manner, with a view to supporting the skirmishing chain, while keeping as much as possible under shelter from the enemy's fire.

(*b.*) The Battery of the Advanced Guard supports the Infantry and keeps at least 2400 metres from the enemy's Artillery.

(*c.*) The Cavalry continues to reconnoitre upon the flanks, and forms, if necessary, a support for the Battery when this last is in position upon a flank, unprotected, and at a distance from the Infantry of the Advanced Guard.

(*d.*) The main body of the Division is halted and forms itself in close order.

(*e.*) The Commander of the Division has taken in hand the direction of the combat, which continues to have a demonstrative character, so long as the object to be attained is not yet perfectly and precisely defined.

Passage from the close-order formation to the Offensive and development of the Attack.

When, from the general situation, the opportunity arises of taking the offensive, the most practical means of ascertaining the enemy's dispositions and of preparing for the action of the Division, is to bring the Batteries of the main body up into line. This order is given by the Commander of the Division to the Commander of the Divisional Artillery, who brings up the Batteries and places them upon the position which he has previously reconnoitred. This position is perhaps chosen by the side of that already occupied by the Battery of the Advanced Guard, so as to mass all the Divisional Artillery from the beginning. If, for any reason, this massing of the Divisional Artillery upon the position of the Battery of the Advanced Guard is impossible or disadvantageous, the Commander of the Divisional Artillery takes care to mass the Batteries during the action upon an advanced position. The transfer of the Battery of the Advanced Guard to act under the orders of the Commander of the Divisional Artillery always takes place, either by order of the Commander of the Advanced Guard, who takes the responsibility of it, or in accordance with a special order which the latter receives from the Divisional Commander.

During this period of the offensive combat, the principal part is played by the Artillery, who have the double mission of protecting the deployment of the Infantry by drawing the fire of the enemy's Artillery upon themselves, and of reducing this fire so as to allow of a decisive attack by the Infantry. With this view, it is indispensable that the whole of the Artillery should come into action from the beginning of the combat.[1]

Whenever the Artillery is threatened by the enemy's musketry fire,

---

[1] This necessity of the rapid and simultaneous entry into action of the whole of the disposable Artillery, ought, before all, to serve as a guide in the choice of positions; and the reconnaissance of ground for this purpose should be made with extreme care. The conviction ought to be paramount that a position is very seldom met with which unites all the conditions theoretically required to make it considered as absolutely good; that ground must be utilized such as it is; and that it is better to open fire from an indifferent position than to risk coming into action too late. In the choice of positions, conditions favorable for the effectiveness of fire rather than for the protection of the guns should be sought for. Above all, very elevated positions should be avoided, which cannot be reached without great effort and loss of time, and which generally have the disadvantage of dead angles in front. Besides, guns placed upon the top of heights stand out clearly against the sky, and present an easy mark to the enemy. For these different reasons, it will be better to take up a position upon the flanks of the heights.

To sum up:—Artillery positions should be chosen which can be quickly occupied, offering a favourable field of fire, and without dead angles.

As for the way in which guns should be brought into action, care should be taken, whenever the ground admits of it, to execute a rapid deployment as much as possible under cover, then to march rapidly forward so as to bring up all the guns at the same time, and unexpectedly, upon the position. The evil will thus be avoided of exposing the guns successively to the enemy, who would dismount them one after the other by his convergent fire, and a moral effect will be obtained greater in proportion to the number of guns and the suddenness of their effect.

To arrive at the proper employment of Artillery masses, the Brigade rather than the Battery should be considered as the tactical unit of that Arm; it is only under exceptional and temporary circumstances, that detached Batteries will have to play a special part.

it ought to be protected in front by Infantry. This last should advance far enough to the front to keep the enemy's Infantry out of effective Infantry range from the Artillery.[1]

The Commander of the Division having decided in what manner the main body is to be engaged, orders its deployment. In principle, the main body should not be brought into line till after the completion of its deployment, in such a manner as to bring it as a whole, and simultaneously, against the enemy, and to avoid the partial and successive engagement of the force.

In a Division acting alone, two Regiments of the main body would be first engaged upon the line of the Advanced Guard, the other Regiment acting in support.

The Regiments called to enter first into action are generally arranged in two lines. Each line is composed of a number of Battalions, varying with the front which has to be occupied.

A Division acting in combination, which is to fight to the last, occupies a front of about 1000 to 1200 metres, and is composed of two Brigades of Infantry, coupled together, each formed in three echelons.

Lastly, a Division acting in combination which is intended for a less organised action, or simply for an armed reconnaissance, can occupy a front of 1500 to 1800 metres with 6 to 8 Battalions in front line, and the others in second, and, if necessary, in third line.

After having formed line of Company Columns at deploying intervals, the Battalions of the first line advance in the direction indicated by the Commander of the Division until their skirmishing line has arrived at a position within the first zone of fire (about 700 metres) or have reached the Battalions of the first line of the Advanced Guard. The Battalions of the second line, and eventually those of the third, are generally formed in line of Company Columns. They conform to the movements of the first line. As a rule, the second line keeps at a distance of 300 metres from the first, and the third at 600 metres from the second.

While the Infantry are marching to the front, the Artillery advances within decisive range of the enemy's Artillery, perhaps less than 800 metres, and keeps up a fire upon them.

When it is considered that the enemy's Artillery is sufficiently shaken, or when it is thought for other reasons that the moment is come to prepare the Infantry attack by a heavier musketry fire, the skirmishing chain is reinforced by troops from the first line. At this point begins the fire for the preparation of the attack, and the Artillery, as we shall see presently, is turned upon the enemy's Infantry. During this time, in the case of an independent Division, the reserve held hitherto in rear is sent to one of the flanks, to menace the corresponding flank of the enemy, or to ward off a possible flank attack. The attack is begun when it is thought that sufficient preparation has been made; that is to say, when it is quite evident that the enemy's fire is losing its power.

---

[1] The Artillery will be able to continue firing upon the enemy, without fear of hitting the Infantry which protects them, so long as the latter keeps about 300 or 400 metres in front of the guns.

Then the Infantry of the first line advances by rushes, and that of the second and third follows its movement, formed in line of Company Columns. The second and third line approach gradually to the first, without however increasing their pace, in consequence of the slowness of the advance by rushes of the first line. The skirmishing chain of the Battalions of the first line, when it has arrived by successive rushes at a distance of about 300 metres from the enemy, opens a rapid fire, and when it has been rejoined by the main body which moves up in line with it, they form together one single mass, which advances to the assault.

When the first line opens its rapid fire, the Battalions of the second, and eventually those of the third line, come still nearer to the first, continuing to follow the movement, formed in lines of Company Columns and ready either to support the line if it encounters an obstinate resistance, or, if the assault is successful, to occupy the captured position promptly.

As has been already said, at the beginning of the preparation of the Infantry attack, the Artillery has a new task to accomplish; it must effectually conduce to the success of the attack by firing upon the enemy's Infantry, who occupy the point upon which the attack will be directed.

If, from its second position, the Artillery cannot ascertain the effects of its fire, nor clearly distinguish the enemy's troops from its own at the decisive moment of the shock, it takes up, when the ground permits it, a new position in front; advancing to within 1000 metres, if necessary, of the enemy's Infantry, upon which it continues to direct its fire.

In exceptional cases, however, at this last moment of the attack, the Artillery will be able to direct the fire of some of its Divisions upon the Batteries of the defence, to diminish the effect of the fire of the latter upon the advancing Infantry.

To assist efficiently in the success of the attack, the Artillery ought not to hesitate, in this last phase of the combat, to expose itself to the enemy's musketry fire even at the cost of serious losses. It is certain, besides, that at this moment the enemy's Artillery will direct its fire in preference upon the Infantry of the Attack, which is more threatening and nearer to the Batteries. The simplest means for the Artillery to effect the change of position indicated above is to execute this movement by echelons. In this way, its fire will not be completely suspended at the very moment when it becomes most necessary to support the forward march of the Infantry. Consequently the echelons should not be under the strength of a whole Battery. At the decisive moment of the attack, the Artillery opens a continued and lively fire against that part of the enemy's front which is most exposed to Infantry attack. The Infantry of the attack and that of the defence may approach near enough to each other to render the Artillery fire dangerous for its own troops. The latter then turns its fire upon the enemy's Batteries, which still take part in the combat, or against the Reserves and the second line in order to prevent them from coming to the support of the first line. If the attack succeeds, the position

taken from the enemy is quickly occupied by the Battalion of the second line, which has suffered least. Part, at any rate, of the Batteries immediately advance to the position. Under the protection of these troops, the Battalions which the attack has thrown into disorder, re-form, and pass in their turn into the second line. If the attack is repulsed, the Batteries in position form the best support to allow the retreating Infantry to rally.

During all the phases of the Attack, the Cavalry covers the flank of the Division. At the decisive moment it ought to seize the opportunity of co-operating in the final success of the enveloping charges. When the issue of the combat is favourable, it confirms the result obtained by a pursuit, in which it is seconded by the Artillery, who have advanced to the conquered position. In order to fulfil this important part, the Cavalry leader will always keep his men in hand. They should certainly avoid exposing themselves unnecessarily, but should never cease to look for an opportune moment to fall unexpectedly upon the enemy's troops with a special view to surprising them upon the march, or while they are endeavouring to re-form. The Cavalry should not remain inactive simply because the enemy's Cavalry do not appear to be in front of them; and their leader will always be very culpable, if, under such a pretext, he neglects to make the best possible use of his troops.

Passage from the close-order formation to the Defensive and development of the Attack.

When, from the general situation, and from the result of the demonstrative combat engaged in by the Advanced Guard, it appears suitable to remain on the defensive; the deployment of the Division can take place either upon the actual front occupied by the Advanced Guard, or upon a position in rear.

In the first case, the part of the Advanced Guard is to secure the forward march and the occupation of the position by the main body, which promptly establishes itself upon the most important point of this position, and maintains itself there with tenacity.

In the second case, the duty of the Advanced Guard is to aid the main body in establishing itself upon the position in rear by checking the enemy, by prolonging his uncertainty, and by inducing him to deploy prematurely, and in the least advantageous direction. With this object, it is generally necessary to keep up a desultory action, deploying and forming in suitable echelons the Battalions and the Battery of the Advanced Guard. In order to retire afterwards upon the main body of the Division, the Advanced Guard must take care to direct itself as much as possible upon one of the flanks of the position, so as to unmask, and the same time to prolong, the principal front of the main body. In both the above-mentioned cases, the Cavalry can render great service, either by covering the flanks or by embarrassing the enemy's manœuvres, and delaying their execution. On the defensive as well, it is usually the Artillery, among the troops of the

main body, which first comes into action. When the principal defence is to be made upon the line already occupied by the Advanced Guard, it is advantageous to bring up the Batteries of the main body at once, and place them as soon as possible by the side of the Battery of the Advanced Guard. The object of these Batteries is to reduce the enemy's Artillery, which is already engaged, to silence. If the principal defence takes place upon a position in rear of that which the Advanced Guard occupies, it is still advantageous to bring the Artillery of the main body into action, with the object of protecting the retirement of the Advanced Guard, and of obtaining over the enemy's Artillery the advantage of first ascertaining the range. The position occupied by the Artillery constitutes the key of the whole defence; it ought to afford a field of fire as extensive and open as possible over the ground available for the attack. With this object positions should be chosen for the Batteries with a view to the power of concentrating their fire in the most efficient manner, both in front and upon the flanks. It is particularly important that the Artillery should be able to act towards the flank, against which a turning movement is especially to be feared, in order, if the contingency occurs, to oblige the assailant to extend the radius of his manœuvres, and to allow the defence to gain time enough to meet him with a counter-attack.

In the defence, the Infantry generally forms itself in two lines with a reserve. The first line establishes its line of fire at least 300 or 400 metres in front of the Batteries. In this way a grazing fire is obtained down the slopes of the position when the latter is on undulating ground, and the useless exposure of the Artillery to the effective fire of the enemy's Infantry is always avoided.

In placing the troops of the first line, it must not be forgotten that their essential object, in the defence as well as the attack, is to cause the greatest possible injury to the enemy. It is also important, but in a less degree, to seek to shelter one's-self from the view and fire of the enemy. Every disposition taken so as to attain the latter object at the expense of the former, and having the effect of diminishing the efficiency of one's own action, should be considered as a serious error. Consequently, every position which does not allow of doing the greatest possible injury to the enemy should be considered as bad, even when it satisfies the conditions required under every other head.

The second line takes up the formation most suitable for obtaining cover from fire, at the same time keeping within supporting distance of the first line.

The reserve keeps itself under cover from the enemy's fire, ready, according to circumstances, to move to the most threatened part of the front, to ward off flank attacks, or to take the offensive against the flanks of the enemy at the moment when the latter is delivering his attack.

The Cavalry is disposed so as to be able to signal in time the turning movements of the enemy, and to be in a position to check them in a suitable manner by its demonstrations and attacks. They ought besides to be able at the right moment to act against the flank of the enemy when he makes a front attack.

As has already been stated, the Divisional Batteries ought to come nto line as soon as possible to protect the troops of the Advanced Guard, and to reply to the enemy's Artillery, inflicting sensible losses upon him before he comes within effective rifle range of the principal position. To obtain this last result, the Batteries of the Defence ought at every period of the action to direct their fire upon important groups of the enemy's Infantry which show themselves within easy range. The favorable moments for this kind of fire are those during which the Batteries of the Attack are changing their position to approach nearer. Sometimes it happens that the assailants having the disposal of a very superior number of pieces establishes such a preponderance of fire that the Artillery of the Defence is certain to succumb to it. In such a case, the latter will be able to take up a new position, from whence it will re-open fire without delay. It may even withdraw for the moment from the contest and get under cover, ready to come again into action unexpectedly, and at any favorable opportunity, against the enemy's Infantry, and particularly when his Infantry is advancing to the attack. So long as the attack is not pushed home, the firing chain of the first line carries on the combat against the enemy's marksmen without losing the opportunity of volley-firing at the enemy's Batteries which come within range.

When the enemy's Infantry begin a hot fire for the preparation of the attack, the supports of the first line come up and reinforce their shooting line. When the real attack of the enemy's Infantry develops itself, *i.e.*, when it is not more than 300 metres from the line of fire, the main body of the first line advances deployed up to the shooting line, and opens a rapid fire. At this period the second line closes upon the first line to be in a position to reinforce it or to repulse the enemy if he succeeds in penetrating the position. The reserve, always kept under the immediate disposal of the Commander of the Division, is then utilized according to the ground which it occupies, and to circumstances in general, either to repair the reverses experienced by the first and second lines, or to resist flank attacks attempted by the enemy, or lastly to make a counter-attack upon the enemy's flank at the moment when he is advancing to the assault.

At the moment of the assault, all the disposable Artillery of the defence comes vigorously into action, and directs a hot fire upon that part of the enemy's Infantry which forms the principal force of the attack. From the beginning of the assault up to the decisive issue of the action, the only object of the Artillery is to bring all its pieces to bear upon the attacking Infantry. They should never on any account be influenced by the possible loss of pieces, and should continue firing without cessation with those which are disabled. No pieces should be taken to the rear without the actual order of the Divisional Commander.

NOTES:

BY VARIOUS HANDS.

The following Notes on curious and valuable books, brought to light in the recent re-arrangement of the R. A. Regimental Library, Woolwich, have been compiled by Lieut. F. L. Nathan, R.A., Secretary, R. A. Library, and are published in continuation of the Notes on the same subject which appeared in "Proceedings," Vol. XII., No. 9, for March, 1884.

Probably the most valuable and interesting book in the Library, is the Atlas of the Blaeu's. This Atlas consists of eight folio volumes. Volumes 1 to 6 constitute the "Theatrum Orbis Terrarum sive Atlas Novus," and were published at Amsterdam between the years 1648 and 1655; they are as follows:—

Volume I.	Europa, Germania, 1649–55.
Volume II.	Gallia, Hispania, Asia, Africa, America, 1655.
Volume III.	Italia, Graccia, 1655.
Volume IV.	Britannia, 1648.
Volume V.	Scotia, Hibernia, 1654.
Volume VI.	Sina et Japonia, sive Novus Atlas, sinensis a Martino, Martinio soc Jesu descriptus, 1655.

The present example of Volume V. is believed to be *unique*, as it contains a highly illuminated sub-title, dedicated to Oliver Cromwell, shortly after his assumption of the Protectorate. This dedication is surmounted by Oliver Cromwell's coat-of-arms, and is as follows:—

OLIVARIO,

DOMINI PROTECTORI,

REIPUBLICÆ,

ANGLIÆ, SCOTIÆ,

ET HIBERNIÆ.

The maps were engraved, from the first survey of Scotland, by Timothy Pont and others, the original draughts of which, after being sent over to Holland for engraving, were deposited in the Advocates Library, Edinburgh, *vide* Gough's "British Topography," Vol. 2.

The bibliography of this rare edition of the Theatrum is very obscure, and known to but few, and almost forgotten by Bibliographers.

Volumes I. and II. were first published by Joannes Blaeu the elder in 1638, the title page being afterwards altered by his two sons as above.

The remaining two volumes are the "Novum ac Magnum Theatrum Urbium Belgicæ, Regiæ et Foederatæ ad praesentis temporis faciem expressum, a Joanne Blaeu. Amstelædamensi, 1649." This is a presentation copy, previous to pagination, with dedication to Philip IV. of Spain, signed, Joannes Blaeu, Guilielmi Filius, printed in Gold. This dedication page is as follows:—

SERENISSIMO,

POTENTISSIMO,

PHILIPPO,

QUARTO,

PACIFICO,

HISPANIARUM

INDIARUMQUE, &c.

REGI CATHOLICO,

PIISSIMO;

BURGUNDIONUM, &c.

PRINCIPI,

FELICISSIMO;

VICTORI

AC

TRIUMPHATORI,

AUGUSTISSIMO;

THEATRUM URBIUM

BELGICÆ,

REGALIS,

MULTO LABORE, ÆRE MULTO

A SE COLLECTUM,

IN PERPETUI CULTUS MONUMENTUM

DAT, DICAT, DEDICAT.

JOANNES BLAEU,
GUILIELMI FILIUS,
AMSTELÆDAMENSIS.

Volume I. Belgiæ Regiæ, Sheets 1 – 92.
Volume II. Belgiæ Foederatæ, Sheets 1 – 132.

The plans of towns are coloured by hand, with their shields of arms illuminated. Believed to be *unique*; the copy in the Royal Library, British Museum is uncoloured, and the title of Volume II. reads "Novum ac Magnum Theatrum Urbium Belgicæ liberæ ac foederatæ."

Therefore the copy in the R. A. Library is the first impression previous to the separation of the Dutch provinces from Spain.

The maps of all eight volumes are engravings, magnificently coloured by hand, and all have titles, more or less highly ornamental. Many also have shields, containing the coats-of-arms of the different countries, divisions, towns, &c., handsomely illuminated with gold and silver. The volumes are bound in red velvet. They have been very recently carefully cleaned and restored.

An entry in the Committee Proceedings of the R. A. Library, dated 5th March, 1810, is as follows:—"The handsome present of Blaeu's Atlas in eight volumes was laid before the Committee, and General Lloyd requested to return their thanks to Col. Garstin, in the names of the Members of the Institution."

Another book of great interest is a copy of "Eikon Basilikê."—"The Pourtraicture of His Sacred Majestie in his Solitudes and Sufferings,"—with the folding plate by Marshall, prefixed. This (the second) edition of Eikon Basilikê was printed in London in 1648, shortly before King Charles's death, but not issued until after. After the execution, "the Prayers used by His Majestie in the time of His Sufferings," delivered to Dr. Juxon, and the King's speech to Lady Elizabeth and the Duke of Gloucester, immediately before his death, were added to the book. Copies were bound in black morocco, black edges, with cross-shaped clasps. The Royal cyphers, "C. R.," surmounted by a crown, and with a skull underneath were impressed in gold on both sides—emblematical of the martyr's death. It is supposed that these copies were distributed, *in memoriam,* among the King's friends. The copy in the R. A. Library, is one of the rare copies in the original binding as above described, one clasp is missing. A copy is in the British Museum at 8122 *a* in later inferior binding.

"Speculum Belli Sacri; or the Looking-Glasse of the Holy War, wherein is discovered: The Evill of War, The Good of Warr, The Guide of War, &c." Alexander Leighton, M.D., born 1568, the author of this book, also wrote "Appeal to Parliament, or Sion's Plea against Prelacie. Printed the year and moneth wherein Rochell was lost" (September, 1628). For writing this work, the author was twice publicly whipped and pilloried in Cheapside, his ears cut off, his nose twice slit, his cheeks branded with a red hot iron with the letters S. S. (Sower of Sedition), and was eleven years imprisoned in the Fleet, 1630.

"The First Book of the Art of Metals, in which is Declared the manner of their Generation and the Concomitants of Them." This curious book was written in Spanish by Albaro Alonso Barba, M.A., in the Year 1640, and translated by Edward Montagu, Earl of Sandwich, in 1669. The sale of Barba's book on metals was prohibited in Spain under the penalty of the Inquisition.

Another interesting book is one published at Nürnberg in 1762. It is a collection of 124 hand-coloured plates, representing the uniforms

of the German Army at that time, together with a short history of the various regiments.

The "Introduction to Logic, dedicated to the Great God, to the Virgin Mary without Sin, and to the beatified Stainslas de Kostka, in company of the Angles," is a curious manuscript in Latin, written in the second half of the 17th Century, presumably by a Jesuit, and was probably used as a text book in Colleges. The following is an account translated from "Hoefer Biographie Générale" of the Stanislas de Kostka mentioned in the dedication:—

Stanislas Kostka (Saint) born in 1550, at the Castle of Rostkow, died on the 15th August, 1568, at Rome. The son of a Polish senator, he distinguished himself from his childhood by his piety. After completing his studies at the College of the Jesuits in Vienna, he expressed his intention of joining their order, but to surmount the obstacles which his father and brother placed in the way of his vocation, he repaired to Dillengen, where the Provincial, Father Canisius, in order to try him, ordered him to wait at table on the pensioners of the college, and to take charge of their rooms. Sent thence to Rome, he was admitted to Holy Orders on the 28th October, 1567. Before 10 months had passed, however, he died, after an illness of a few days, at the age of eighteen. Clement VIII. beatified him in 1604, and Clement XI. canonised him. His body is buried at Rome in the Church of Saint Audré. His Saint's day is the 13th November.

A scarce book is "The Prospective Glasse of Warre, Shewing you a glimps of Warres Mystery, in her admirable Stratagems, Policies, Wayes, &c.," published in London in 1628. It was written by Edward Cooke, and dedicated to "The Honorable Sir John Cooke, Knight, Principall Secretarie of State to his Majestie." It contains four quaint woodcuts of battle formations for the three Arms, and two of the battle formation of a Roman Legion.

The commencement of "A Letter to a Member of Parliament concerning the four Regiments commonly called Mariners," published in London in 1699, is rather amusing, it runs: "Sir,—In my last I undertook to shew that the Establishment of the four Marine Regiments is an useless Charge to the People, a Nusance to the Navy, and dangerous to the Kingdom's Liberties." With this letter are bound up "Lawes and Ordinances of Warre," for the years 1639, 1642, and 1652. Also "A short History of Standing Armies in England," 1698, and "Articles de Guerre de François III.," 1739.

"Theorike and Practike of modern Warres, discoursed in Dialogue-wise, by Robert Barret," London, 1598. According to Lowndes, George Chalmers says that Shakespeare evidently alludes to this work in his "All's Well that Ends Well." Act IV., scene 3.

A scarce and interesting Military work is Colonel Robert Monro's account of "His Expedition with the worthy Scots Regiment (called Mac-Keyes Regiment) levied in 1626, by Sir Donald Mac-Key, Lord Rhees. This Regiment, according to the title page served, first under the King of Denmark during his wars against the Emperor, afterwards

under the King of Sweden during his life time, and then under the Director-General, the Rex-chancellor Oxensterne and his Generalls. It was reduced after the Battle of Nerling to one company in September, 1634, at Worms in the Paltz.

An unsigned manuscript note on the first page is as follows :—" This book is exceeding scarce, being printed at the sole expense of Lord Rhees, and most of the copies (which were but few) given to his friends," *vide* " Stricture on Military Discipline," Preface, p. 5, work p. 154, &c., where the great scarcity of this book is mentioned.

A German work on "Fortification," by Daniel Speckle, the architect of the city of Strasburg, published at Strasburg in 1608, contains some very fine engravings. It also has facing the title page an unsigned and undated manuscript note which runs,—" This is the most scarce and most valuable book of Fortification in any language. It always sells for an extraordinary price in Germany, and is an uncommon curiosity in England. This copy formerly belonged to General Napier, who paid £2 12s. 6d. for it, in Germany. Sold in Payne's catalogue for 1773, for 3 guineas. *See* " Horneck's remarks on Modern Fortification," Introd, pp. 6 & 7. *See* " Robin's Mathematical Tracts, published by Dr. Willson, preface, p. 9, &c."

"The Great Art of Artillery of Casimir Simienowicz," translated from the French by Shelvocke. Illustrated with 22 copper plates, London, 1729. On the title page is the following in General Borgardt's handwriting :—" A present from Colonel Armstrong, Surveyor Generall. July 4, 1729. Albert Borgardt."

A Folio Volume in black letter, gilt edges, bound in leather, with the coronet of Thomas, Earl of Pembroke on the side, contains the Acts of Parliament of 1604 (the first year of the reign of James I), 1606, 1607, 1610 and 1624. Also those of 1625 (the first year of the reign of Charles I) and of 1627.

Another Folio work contains four volumes bound in one. The first is "Acts of Parliament made in the first Parliament of Charles I. ;" held in person, at Edinburgh in 1633. The second is, " Laws and Acts of the first Parliament of Charles II.," held by commission in Edinburgh, in 1661. The third is "The Laws and Acts past in the second session of the first Parliament of Charles II.," held by commission in Edinburgh in 1662. The fourth is "Laws and Acts past in the third session of the first Parliament of Charles II.," held by commission in Edinburgh in 1663. At the end of this volume is an " Act rescinding two Acts passed in the last session of Parliament, Edinburgh, 1663. This is in black letter. The latter two volumes of this book are not in the British Museum. (May, 1884).

"Trattato di Scientia d'Arme," by Camillo Aggrippa, dedicated by the author to Cosmo de Medici, Duke of Florence; and published in Rome in 1553, is, according to Brunet, (Manual du Libraire). "Fort recherchi, à cause des figures qui sont dans le style de l'école de Marc Antoine." The book is a Treatise on Fencing, and certainly contains numerous very curious engravings.

J O H N, DUKE of MONTAGU, &c. *One of His Majesty's most Honourable Privy-Council, Great Master of the most Honourable Order of the Bath, Knight of the most Noble Order of the Garter, Master of the King's Grea Wardrobe, Colonel of the Queen's Ro Regiment of Horse, and* Master eral *of the* ORDNANCE, &

TO James Elliott Bombardeer.

BY Virtue of the Author by the King's most Excellent Majes Behalf given, I do hereby Nomin and Appoint you the said James to be one of the Bombardiers longing to his Majesty's Royal Regiment o Artillery, whereof Lt.Genl. Albert Borgard Colonel. You are therefore carefully and dili y to discharge the Duty of a Bombardeer the said Regiment, by doing and performing all Manner of Things thereunto belonging; likewise to observe and follow such Orders and Directions, you shall from Time to Time receive from your Colonel, Captain, or any other your Superior Officer ccording to the Rules and Discipline of War. Given at the Office of Ordnance, under my Han and Seal, this First Day of July, 1743, in the Seventeenth Year of His Majesty's Reign.

Montagu

By Command of His GRACE *the Master-General of the Ordnance.*

James Cockburn

Entred in the Office of Ordnance 22d day of July 1743.

W. R. Earle. Cl. Ordnce

RULE XIX.

"The Institution will bear a share (not exceeding two-thirds) of the expense of a class at any out-station at which as many as three of its Members will combine for the purpose.

"The class to designate one of their number who will engage to furnish a return of the Members present at each attendance of the Master, and to manage the payments. An account to be sent quarterly to the Secretary of the Institution."

The Committee is further authorized to assist, at its discretion, from the Funds of the Institution, any Member desirous of professional instruction.

LIST OF BOOKS, &c.,

most of which can be procured at the Royal Artillery Institution by Members.

[THE PRICES QUOTED BELOW ARE EXCLUSIVE OF POSTAGE.]

Lists, Rosters, &c.

KANE'S LIST. Revised Edition. List of Officers of the Royal Regiment of Artillery, from the year 1716 to the present date. Price 2s. 6d. Under 3 lbs.

ALPHABETICAL LIST OF THE OFFICERS OF THE ROYAL REGIMENT OF ARTILLERY. Published quarterly. Price 6d., or by Annual Subscription, giving four copies, 1s. Under 2 ozs.

REGIMENTAL LIST. Showing Distribution by Districts, and containing Roster of Batteries for Foreign Service and Relief. Under 2 ozs. Published occasionally. Can be obtained gratis upon application.

LIST OF SERVICE ORDNANCE AND AMMUNITION. Published occasionally. A copy is sent to each Member, gratis, with the first number of the "Proceedings" issued after its publication. Further copies can be obtained by Members at the rate of 2d. each. Under 4 ozs.

OFFICIAL CATALOGUE OF THE MUSEUM OF ARTILLERY IN THE ROTUNDA, WOOLWICH. Price 1s. 6d. Under 12 ozs.

LIST OF CHANGES IN WAR MATÉRIEL. Published by the War Office. Gratis. Under 2 ozs.

Proceedings, R.A.I., and D. of A., &c.

MINUTES OF PROCEEDINGS OF THE R.A. INSTITUTION. Vols. III., IV., V., VI., VII., VIII., IX., X., and XI. Vols. I. and II. are out of print. Members can obtain single numbers of the "Proceedings," the prices of which vary according to contents.

EXTRACTS FROM THE REPORTS AND PROCEEDINGS OF THE DEPARTMENT OF THE DIRECTOR OF ARTILLERY AND STORES. Published quarterly.

Handbooks, &c.

HANDBOOK FOR FIELD SERVICE. Vol. I. Field Artillery. Price, to Members and N.-C. Officers (through their Commanding Officers), 2s. 6d. Under 12 ozs.

THE ARTILLERIST'S MANUAL, AND BRITISH SOLDIER'S COMPENDIUM. Eleventh Edition. Edited by Majors L. Griffiths and F. Duncan, R.A. Price 4s. 2d. Under 8 ozs.

THE ARTILLERIST'S HANDBOOK OF REFERENCE. By Capt. Will, R.A., and Lieut. Dalton, R.H.A. Price 5s. Under 1 lb.

TEXT BOOK ON MILITARY TOPOGRAPHY. By Colonel W. H. Richards. Temporarily out of print.

GUIDE TO SIMPLE FARRIERY. By Capt. J. Hotham, R.A. Gratis. Under 2 ozs.

MILITARY DICTIONARY. Compiled by Maj.-General G. E. Voyle, *late* R.A. Price 10s. 6d. Under 1½ lbs.

MILITARY TRANSPORT. By Lieut.-Col. Furse, D.-A.-Q.-M.-G. Price 3s. 6d.

Artillery and Gunnery, &c.

THE PRINCIPLES AND PRACTICE OF MODERN ARTILLERY. By Lieut.-Col. C. H. Owen, R.A., late Professor of Artillery, Royal Military Academy, Woolwich. 2nd Edition. Price 12s. 6d. Under 3 lbs.

TEXT BOOK ON GUNNERY. By Capt. G. Mackinlay, R.A. Price 3s. 6d. Under 1 lb.

FIELD ARTILLERY. ITS EQUIPMENT, ORGANIZATION AND TACTICS. By Major S. C. Pratt, R.A. Price 4s. 6d. Under 1 lb.

MANUAL OF GUNNERY FOR H.M. FLEET, 1880. Price 5s. Under 2 lbs.

ON THE MOTION OF A PROJECTILE IN A RESISTING MEDIUM. By Professor A. G. Greenhill, M.A. Price 6d. Under 4 oz.

USEFUL TABLES. By Major W. H. Noble, R.A. 2nd Edition. Price 1s. 2d. Under 4 ozs.

Drill Books, &c.

MANUAL OF SIEGE AND GARRISON ARTILLERY EXERCISES. Vols. I. and II. Price 2s. 6d. Under 1¼ lb.

INSTRUCTIONS FOR THE SERVICE OF SIEGE ARTILLERY, 1880. Price 3s. 2d. Under 1 lb.

HEAVY GUN DRILL. Compiled by Major W. O. Carlile, R.A. Gratis. Under 4 ozs.

MANUAL OF FIELD ARTILLERY EXERCISES. Interleaved. Price 2s. 8d. Under 3 lbs.

FIELD EXERCISES AND EVOLUTIONS OF INFANTRY. Temporarily out of print.

REGULATIONS FOR THE INSTRUCTION AND MOVEMENTS OF CAVALRY. Temporarily out of print.

REGULATIONS AND INSTRUCTIONS FOR ENCAMPMENT. Price 5d. Under 4 ozs.

MANUAL OF ELEMENTARY FIELD ENGINEERING, 1883. Price 1s. 2d. Under 6 ozs.

Manufacture of Matériel, &c.

TREATISE ON THE CONSTRUCTION OF ORDNANCE, 1879. Temporarily out of print.

TREATISE ON AMMUNITION, 1881. Temporarily out of print.

NOTES ON AMMUNITION, 1881. Price 1s. 9d. Under 1 lb.

HANDBOOK OF ARTILLERY MATERIEL. By Captain F. C. Morgan, R.A. Price 4s. 3d. Under 8 ozs.

TREATISE ON MILITARY CARRIAGES, and other Manufactures of the Royal Carriage Department, 1879. Temporarily out of print.

HANDBOOK FOR MILITARY ARTIFICERS. Price 2s. 3d. Under 6 ozs.

PRICED VOCABULARY OF STORES, 1879. Price 4s. 6d. Under 2½ lbs.

TREATISE ON MILITARY SMALL ARMS AND AMMUNITION. By

Interior Economy, &c.

MANUAL OF INTERIOR ECONOMY. By Major O. H. Goodenough, R.A. Price 4s. Under 1 lb. 2 ozs.

OFFICE MANUAL, 1882, FOR HORSE, FIELD, AND GARRISON BATTERIES OF ROYAL ARTILLERY. Edited by Lieut.-Col. R. W. Phipps, R.A. Price 2s. Under 12 ozs.

Military Law and Regulations, &c.

ARMY ACT ALPHABET. By Capt. Will, R.A. Price 1s. 8d. Under 4 ozs.

W.O. MANUAL OF MILITARY LAW, 1884. Price 1s. 9d. Under 2 lbs.

MILITARY LAW: its Procedure and Practice. By Major S. C. Pratt, R.A. Price 3s. 6d. Under 12 ozs.

MILITARY ADMINISTRATION AND MILITARY LAW. By Lt.-Colonel J. Boughey. 8th Edition. 1883. Price 5s. Under 1 lb.

A HANDY TEXT-BOOK ON MILITARY LAW. By Major F. Cochran. Price 5s. 9d. Under 1 lb.

HINTS ON COURTS-MARTIAL. By J. C. O'Dowd. Price 3s. 6d. Under 8 ozs.

ANALYSIS OF CRIMES AND PUNISHMENTS; Army Act of 1881. By Capt. S. C. Pratt, R.A. Gratis.

QUEEN'S REGULATIONS, 1881. Interleaved. Price 2s. 8d. Under 3 lbs.

ROYAL WARRANT; PAY, PROMOTION, &c., 1884. Price 1s. 2d. Under 12 ozs.

DRESS REGULATIONS FOR THE ARMY. 1883. Price 1s. 6d. Under 14 ozs.

Regimental and Military History, &c.

HISTORY OF THE ROYAL ARTILLERY. By Major F. Duncan, R.A. 2 Vols. Price 13s. 6d. Under 5 lbs.

THE ENGLISH IN SPAIN; OR THE STORY OF THE WAR OF SUCCESSION IN 1834–40. By Major F. Duncan, R.A. Price 12s. Under 2¼ lbs.

CORUNA TO SEVASTOPOL: The History of "C" Battery, "A" Brigade (*late* "C" Troop), R.H.A. By Colonel F. A. Whinyates, *late* R.H.A. Price 11s. 8d. Under 2 lbs.

RECORDS OF THE HORSE BRIGADE. By Col. J. E. Michell, C.B., R.H.A. Price 8s. 9d. Under 1½ lb.

HISTORY OF THE BENGAL ARTILLERY. By Lieut.-Col. F. W. Stubbs, R.A. 2 vols. Price £1 13s. 6d. Under 2 lbs. and 1½ lb. respectively.

FRANCO-GERMAN WAR, PRÉCIS OF. By Captain Pratt, R.A. Price 4s. 6d. Under 1 lb.

SHORT NOTES ON TACTICS AND RECONNAISSANCE. By Captain J. R. J. Jocelyn, R.A. Price 2s. Under 8 ozs.

MILITARY MAPS AND BOOKS, published "by authority," can be obtained by officers *direct* from the Topographical Department, War Office, **post free,** a District Paymaster's receipt being forwarded with the demand. (*Vide* Clause

VELOCIMETER WITH TUNING-FORK AND ELECTRIC REGISTERS.

Reprinted from "U.S. Ordnance Notes," No. 313.

COMMUNICATED BY

MAJOR W. B. HEMANS, R.A.

The velocimeter most frequently employed in the experiments made by the French Marine Artillery service at the proof-ground of the Sevran-Livry powder works, near Paris, is an apparatus in which the simultaneous registering of the times and the signals are given by a tuning-fork caused to vibrate by electro-magnets, which inscribes its tracings on a steel band drawn by the gun. This arrangement has the advantage of enabling tracings to be obtained whose length has no other limit than the length of the recoil of the gun.

The apparatus, which is portable, not cumbersome, and susceptible of working in all positions, may also be easily complemented by the addition of electric registers, so as to indicate the course made by the band, at the moment when ruptures of the current are produced caused by the gun or by the projectile, and especially the ruptures produced by the passage of the latter into the velocity-screens. It constitutes, in this case, a chronograph susceptible of replacing the apparatus of that kind which are generally used for measuring the velocity of projectiles. It possesses the advantage, over these latter, of being placed upon the firing ground, under the eyes of the experimenters; but, on the other hand, it requires a rather long time for calculating the results, which would not permit of its being employed advantageously in certain kinds of investigations, in which the charges employed have to be varied during the progress of the experiment, until a determined velocity is obtained for the projectile.

The velocimeter with fork and electric registers may also be easily transformed into a chronograph for general use, independent of the recoil movement of the gun, and is capable of measuring the duration of phenomena entirely different. It suffices, for this purpose, to operate the traction of the band by any means whatever, by hand, for instance, arranging the velocimeter in such a manner that this same traction determines, at the desired moment, the production of the phenomenon

to be registered. It is thus that this apparatus has been employed for measuring the comparative velocity of the transmission of fire, by means of different kinds of primers, or even the velocity of the transmission of detonation in trains of dynamite, guncotton, or various other explosive substances.

We will also describe in this chapter, under the title of chronograph-velocimeter, the apparatus thus arranged, because it differs too little from the velocimeter designed simply for the study of the recoil to require a separate treatment.

Two models of velocimeters have been constructed, which differ only in their minor arrangements. That of the second model is figured on the Plate, which indicates also its transformation into a chronograph; it is only necessary to suppress, in imagination, the organ for communicating fire, consisting of the second friction rod placed on the left side of the axis and designated by the letter P, to have the simple velocimeter.

First, considering only the organs designed for registering the law of recoil, the apparatus is composed (Figs. 1 and 2) of a flexible steel ribbon, A, of suitable length, which slides in horizontal bearings, BB, fixed on a mahogany plane-table, C, which bears the whole apparatus.

The bearings or slide frame is formed of two reglets of white brass, each provided, on their inner face, with a groove in which the edge of the steel ribbon enters; one of the reglets only is stationary, the other is kept in its place by the aid of screws entering into grooves which permit of varying the distance between them, so as to give the means of employing ribbons of various widths, according to the number of registers to be used.

The ribbon is pierced with a hole at its extremity, and enters into the cleft of a small brass nipper, *d*, in which it is secured by means of a pressure-screw which passes through the hole.

The nipper is itself screwed on the extremity of a steel wire, D, flexible in every direction, but strictly inextensible, which is terminated at the other end by a small articulated eye-strap, which can be attached to the point of the gun or carriage whose recoil is to be studied.

The plane-table is fixed near the gun, on a support, so arranged as to keep it on a level with the point of attachment, the slide-frame being adjusted in the direction of the recoil. The ribbon, whose upper face is covered with lamp black, is then drawn with the gun, and follows the movement of it whatever may be its length.

Above the ribbon is arranged horizontally a small arbor e'' (Fig. 3) which is mounted with a tight friction in two bearings, and is terminated by a small lever by which slight angular displacements are imparted to it. A pressure-screw, *v*, placed on one of the bearings, secures it completely in any desired position. This arbor supports, in its centre, an electrically supplied vibrating tuding-fork, and arranged so as to receive the movement of the lever-arm which imparts to it the angular displacement of the arbor, without ceasing to vibrate regularly in all its positions.

The electric supply movement is given to this fork by the improved process of Mr. Marcel-Deprez, in which the flexible plate on one of the

branches of the fork oscillates between two thumb-screws, the one insulated, the other a conductor, which it touches alternately.

The organs of electric supply, electro-magnets, and supports of the thumb-screws are mounted on a solid metallic frame, *e*, which supports also the fork, and which is terminated by a clamp, *e'* which a pressure-screw secures firmly on the arbor support in any inclined position desired. The whole system may thus receive a lever movement, by the rotation of the arbor, without the vibratory movement of the fork being altered by it.

One of the branches of the fork is terminated by a small, finely-cut steel pen which, by this lever movement, may be brought in contact with the blackened face of the steel ribbon.

A second similar pen, mounted on a transversal rod which admits of being displaced laterally, can be brought in a stationary position by the side of the preceding one and placed on its exact prolongation when the fork is at rest; under these conditions, if the ribbon is displaced, the tracings produced by the two pens are superposed and form only one line.

If the tuning-fork is set in vibration and the ribbon is first left stationary, the vibrating pen produces only a small transversal tracing, owing to the superposition of the successive tracings of its passage; but if the ribbon is displaced, drawn, for instance, by the gun, the tracings which correspond to each oscillation are separated and form an undulating curve, while the stationary pen leaves a tracing in a right line which constitutes the median of the sinusoid.

The divergence of the successive points of contact of this median line, and the undulated tracing, shows the paths of the gun for intervals of time exactly equal to the duration of the simple vibration of the fork; and the registering is evidently produced over the whole extent of the movement imparted to the ribbon, provided that the latter is sufficiently long.

The observation of the tracing is made by means of a microscope with a vertical axis and cross-hairs mounted on a slide, moved by a micrometic screw.

By means of the measurements thus obtained we can construct with great precision a curve which gives the courses of the gun as a function of time.

If we take the first differences of the successive paths we deduce from them, by a simple proportional calculation, the corresponding velocities of recoil: and if we take the second differences, we easily obtain the accelerating forces when we know the masses set in motion.

We may use, with this apparatus, a tuning-fork giving 1500 simple vibrations a second; but the management is then a little difficult, and it is better to be satisfied with a tuning-fork giving 1000 vibrations, which is very easy to set in operation, and whose movement is maintained a long time without any difficulty.

In order to make of this same apparatus a chronograph capable of measuring the durations of the trajectory of projectiles, either in the bore or in the air, it suffices to place near the fork small Marcel-Deprez electric registers, putting them in connection with the electric

circuits designed to be broken by the projectile, and arranging them in such a manner that their pens trace as many parallel tracks on the surface of the ribbon in motion.

A small arbor, *g*, of an insulating substance, placed parallel to that which bears the tuning-fork, and moveable like it, with a stiff friction, in two bearings, serves to support the small registers G, G, which may be placed side by side and connected with as many terminals, *h*, *h*, placed on the side of the plane-table, and to which the wires H, H, of the electric circuits are attached.

Putting, for example, one of the registers in electric communication with an interrupter designed to be encountered by the projectile on its leaving the bore, we obtain on the ribbon, drawn at this same moment, by the recoil movement of the gun, a tracing showing the moment of the projectile's leaving the bore.

By employing two other registers, put in communication in the same manner, with velocity-screens placed on the trajectory of the projectile, we determine the instants of the passage of this latter through these two screens, and thus we can measure its velocity at the same time as the duration of its trajectory in the bore.

With the apparatus of the new model we can employ as many as five registers, and thus obtain five distinct signals, requiring only one signal from each register we can then either place two other velocity screens on the trajectory of the projectile, or employ other interrupters fixed in the bore, or else register other phenomena connected with the firing of the gun, provided, however, that the signals to be registered are posterior to the first displacement from the recoil of the gun.

Although the Marcel-Deprez registers have an extremely rapid movement and a functional retardation, which may be reduced to about one two-thousandth of a second, the degree of precision usually aimed at in these experiments would not permit of neglecting this retardation, and its value must be carefully ascertained for each register.

Besides, as this retardation is slightly variable with the conditions of the experiment, the nature and force of the batteries, the resistance of the circuits employed, an arrangement was sought which permitted this measure to be effected by a simple operation and before the firing of each shot if it is desired.

For this purpose, the electric wires coiled about the electro-magnets of the registers are united, on their leaving these electro-magnets, in a common circuit which ends in a metallic rule, K, parallel to the slides which guide the ribbon. From this rule and through the medium of a metallic spring, *m*, which is in contact with it, the current comes into a piece, M, secured by an insulating clamp to the wire which draws the ribbon. On the rule is fitted, in addition, a small ivory insulating tongue, N.

When the gun recoils, drawing with it the ribbon and the moveable piece, M, the currents which actuate the registers, first established by the contact of the spring and the metallic rule, are broken simultaneously during the very short time of the passing of the spring over the insulating tongue; the pens of the registers then trace each a small crook, then they are returned into the prolongation of their

original tracing, at the end of a very short time, when the spring comes again on a metallic part. These are the signals, thus traced by the registers, which show the functional retardation proper to each of them.

We commence in a preliminary experiment, by bringing with the hand the ribbon and the slide, M, which it carries into such a position that the contact edge of the spring comes exactly on the line of separation of the insulating tongue and the metallic rule; at this moment the pens of the registers trace transversal paths which indicate the exact geometrical position of the extremity of each of them on the ribbon, when the rupture of the current is produced.

If, afterwards, we repeat the experiment of the simultaneous rupture of the currents, by making the ribbon move rapidly, after having set the fork in operation, we obtain new signals whose tracings are distant from the preceding ones in quantities which represent respectively the functional retardations of each of them, and which may be estimated in time, by the aid of the indications furnished by the tracing of the fork.

This production of the signals designed for measuring the retardations of the registers can be determined by the displacement of the ribbon caused by the firing. If, in fact, the common circuit which passes through the rubber spring is established for the experiment, the pens of the registers, at the moment of firing, each trace a path of a certain length, before the spring comes on the insulating tongue; at the moment when it comes there, the pens trace their path of disconnection; they remain disconnected while the spring is on the insulating part; at the moment when the current is re-established, the registers are attracted again automatically, the pens then trace their paths of connection and are ready to give the signals which correspond to the working of the interrupters put in connection each of them.

The last tracing left by each pen gives, by its distance from the origin of the tracing, the measurement of the time elapsed from the commencement of the recoil until the rupture of the corresponding current; this time, however, is liable to error, owing to the functional retardation of the register; but the first tracing left by the pen gives, by its distance from the tracing obtained in the preliminary displacement of the ribbon, effected without velocity, the measurement of the retardation of disconnection, and furnishes, in consequence, the correction to be applied to the duration measured.

We see that it suffices, in order to operate in this manner, that the interrupting tongue, N, whose length must necessarily be very small, is encountered promptly on the displacement of the ribbon, in order that the registers may have time to work and to be attracted again before the ruptures of the current are produced which they have to register.

It is proper, however, that this encounter should take place only when the ribbon has acquired a velocity great enough to give a sufficient extent to the undulations of the fork which serve for the measurement of the durations.

In order to permit the position of the tongue to be properly regulated, to satisfy this condition, the rule, K, which bears it, enters into a metallic slide more or less deeply, and is secured in the desired position by means of a pressure-screw.

The common circuit which unites all the wires of the registers and

communicates with this rule is completed by the friction piece, *m*, drawn by the ribbon; it cannot then naturally subsist during all the time necessary for the measures of the durations to be registered, unless the rule presents a sufficient length for the contact of the friction spring to cease only after the production of the last rupture of current to be noted.

In the apparatus of the first model, the friction piece drawn by the ribbon is disengaged from the rule at its extremity, and carries with it the conducting wire attached to the terminal which surmounts it. In the apparatus of the second model, the extremity, P, of the rule, which is formed of two pieces mortised one in the other, separates and is drawn by the gun.

The rapid motion of the Marcel-Deprez registers, which can easily be regulated so as to give more than 1,000 signals per second, permits of employing them in the manner just indicated for giving the measure of their functional retardation during the same experiment, when the first signal required of them is, for example, produced by the projectile's leaving the bore. They have, in fact, time to work and to be attracted again during the time of the trajectory of the projectile in the bore. Since this duration generally exceeds one one-hundredth of a second, and the extent of the corresponding recoil, at least for large calibres when it exceeds 2 centimetres (0·787-inch), permits of installing the insulating tongue in the proper position.

But if we wish to register nearer signals, or to dispense with the obligation to employ registers with a movement so rapid or so well regulated, we may effect the measure of the retardations of these registers, in a preliminary operation, by simply moving the ribbon by hand; we then avoid, in firing, making the current pass through the friction spring, and we attach the common return wire to a terminal placed on the metallic slide, which suppresses all simultaneous rupture of the currents. We can, in this case, be content with registers working simply by disconnection, which are always more easily managed.

The distances of the successive signals of the registers, at the origin of the tracing of each of them, are read by means of the micrometric apparatus, which serves also to make the readings of the tracing of the fork.

We can thus trace each of these lengths on the tracing of this fork, so as to determine the exact position which each of the signals would occupy on this scale of times if all the pens of the registers were in strict accord with that of the fork.

We estimate the time corresponding to each signal, from the origin of the movement, by counting the entire number of vibrations inscribed from the origin to the signal, and determining, by a proportional calculation, the fraction of complementary vibration.[1]

---

[1] This method supposes only that the movement is uniform during the vibration of the fork, which the signal comprises; the error resulting is, in this manner, absolutely of no importance in practice. If greater precision were desired, we could still measure the lengths of the vibration which follows and that which precedes, to determine the corresponding acceleration of the movement supposed to be uniformly varied, and calculate the complementary duration according to those data; but this manner of operating introduces a corrective term, useful only for the portion of the recoil movement, which corresponds with the first instants of the displacement of the gun when the projectile is displaced only a few centimetres.

The micrometric apparatus permits of reading the hundredth of a millimetre, which corresponds with a duration of one five-hundred-thousandth of a second, if the gun is supposed to be animated with a recoil velocity of 5 metres (16·404 feet); but in the portion where the retardations of the registers are measured, the velocity is much less; and we may admit that the precision of the readings does not much exceed the one one-hundredth-thousand of a second. We know, on the other hand, that the variations of retardation of the registers do not amount to one fifty thousandth of a second; we may therefore admit that the apparatus gives at least a precision of this order.

This apparatus has been employed with the greatest facility in determining the law of the recoil movement of guns of all the models in service, whatever might be their kind of carriage; and it has especially determined the mode of action of the divers kinds of brakes employed for moderating the recoil, and, among others, the different systems of hydraulic brakes. It has also registered the law of the recoil of a gun resting freely on its trunnions, on slides arranged horizontally for a certain distance, then rising again in an inclined plane, which arrangement permits of the development of the accelerating forces created by the combustion of powder being studied with greater precision.

By the aid of the register put in connection with an interrupter placed at the muzzle of the piece, we have been able in all these experiments to note exactly the extent of the recoil at the moment the projectile leaves the bore; and we have thus been able, by constructing the curve of the velocities of recoil, to ascertain for all the guns experimented with how long and over what extent the velocity of recoil continues to increase after the moment that the projectile leaves the bore.

By operating, for example, with a 24 centimetre (9·449-inch) gun, model 1870, mounted on an experimenting carriage, and firing a projectile of 144 kilogrammes (317 pounds), with a powder charge of 28 kilogrammes (61·729 pounds), which imparted to it an initial velocity of 450 metres (1,476 feet), it was found that the gun and its carriage run, on an average, 30 millimetres (1·181 inches) during the time that the projectile is passing the length of the bore, which time is a little over one one-hundredth of a second, exactly 0·0114. The velocity of the system is then 3·80 metres (12·86 feet), and it increases so as to reach a maximum of 5·20 metres (17 feet), which is produced at the end of a time equal to 0·048 second, that is to say, when the gun in recoiling has run about 0·20 metre (0·656 foot), and when the projectile is at the most 15 metres (49·213 feet) from the gun.

Chronograph-Velocimeter.

In order to transform the velocimeter just described into a chronographic apparatus susceptible of being applied to the registering of the durations of any phenomena whatever other than those which are produced during the recoil of a gun, it suffices, as we have said before, to effect directly, by any means, the displacement of the blackened

ribbon, and to furnish the apparatus with an organ which determines the production of the phenomenon to be registered during the duration of this displacement.

The Plate represents the arrangement given to this organ by Mr. Letard, of the Artillery, who was charged with the execution of the velocimeters hitherto constructed. He simply arranged symmetrically, with reference to the axis of the ribbon, a second metallic rod, K_1, on which rests a friction-piece, M_1, also drawn in the movement of the ribbon, and connected by a flexible wire with the special battery designed to cause the inflammation of the primer or the electric tube.

The rod itself communicates with this battery; but it has jointed on it an insulating band, N_1, on which the spring usually rests, so that the current is interrupted at the usual time; but when the friction-piece drawn by the ribbon is displaced, it rests, at the end of a certain time, on the metallic part of the rule, and thus causes the inflammation.

In order to produce this effect at the propitious moment when the ribbon is displaced a sufficient quantity to have acquired a suitable velocity, the rule is arranged in such a manner that the course of the friction-piece over the insulating part might be increased or diminished at will. For this purpose this rule penetrates by its insulating part into a metallic groove in the plane-table, more or less deep, and secured in any position by means of a pressure-screw.

The metallic part designed to establish the ignition is thus approached or removed at will from the starting point of the rubber.

The symmetrical rod designed to produce the simultaneous rupture of the currents of the registers, for the determination of the retardation of the working of these latter, may be always placed in such a relative position that the signals of retardation are produced before the inflammation, so that we may be sure that the currents will be re-established and the registers ready to work at the moment when the phenomenon is produced which we wish to study.

If the registers are put in communication with as many very fine wires placed at measured intervals along a quick-match or a train of detonating substance, so as to be broken by the explosion, and if the electric primer, put in communication with the friction-piece, is arranged so as to cause the inflammation of the quick-match or the detonation of the substance, the apparatus can make known the velocity with which the explosion traverses the successive intervals of the interrupting wires.

The apparatus was employed in this manner in the experiments made by the Committee on Explosive Substances, in order to determine the velocity of the transmission of fire by quick-matches or instantaneous fuzes, and the velocity of the transmission of detonation in trains of dynamite and guncotton. In the first case, velocities were obtained, at the furthest, of 100 to 200 metres (328 to 656 feet) per second. In the second case, we have been able to obtain velocities exceeding 5,000 and 6,000 metres, (16,400 and 19,680 feet), a result in accord with those already observed in England and Austria.

WAR SERVICES

OF

CERTAIN OFFICERS OF THE REGIMENT WHICH ARE NOT GIVEN IN KANE'S LIST, AND OF CERTAIN OTHERS WHICH ARE ONLY IMPERFECTLY GIVEN.

COMMUNICATED BY

GENERAL SIR J. H. LEFROY, C.B., K.C.M.G., F.R.S., LL.D., R.A.

No. 3.

MAJOR-GENERAL WILLIAM PHILLIPS,

Died at St. Petersburgh in Virginia, 13th May, 1781.

He was appointed a Gentleman Cadet, 1st August 1746, and a Lieutenant Fireworker on the 2nd January of the following year.

He held the appointment of Quarter Master of the Royal Regiment of Artillery from the 1st April, 1750, until May 1756, receiving during that period his commission of 2nd Lieutenant (March 1755) and 1st Lieutenant 1st April, 1756.

Lieutenant Phillips was Aide-de-Camp to Sir John Ligonier, Lieut.-General of the Ordnance; and on 12th May, 1756, received the commission of a Captain of a Company for the purpose of proceding to aid in defence of Minorca, then besieged by the French.

Captain Phillips never held the rank of Captain-Lieutenant.[1]

He is particularly mentioned in Smollett's History for his distinguished services with the allies in Germany, more especially during the actions of Minden and Warburg.

[1] This paragraph may convey an incorrect impression. Phillips was appointed as a Lieutenant to the command of a *Company of Miners* specially raised in 1756 for service in Minorca. When this Company was afterwards drafted into the Regiment as a Company of Artillery, Phillips was transferred with it as a Captain, over the heads of his seniors.—*H.W.L.H.*

At the battle of Minden, 1st August, 1759, Major Phillips commanded the Artillery, and His Serene Highness Prince Ferdinand, in thanking the troops after the battle, presented Captain Phillips with 1000 crowns as a testimony of his great satisfaction at his gallant behaviour in the action, as well as a mark of his particular esteem.[1]

At the Action of Warburg, 30th July, 1760, the Marquis of Granby stated that the British Artillery commanded by Captain Phillips, made such expedition that they were in time to second the attack in the most surprising manner, and the retreat of the French was attributed to the effect of the British cannon and Dragoons.[2] No doubt Major Phillips shared in the other engagements of the allies of the same year, viz. :—Emsdorff, Kloster-Kampen, Fritzlar, Cassel, and Kirchdenkern.

On the 15th August, 1760, Major Phillips was promoted to the rank of Lieut.-Colonel in the Army, and succeeded to the rank of Colonel in the same, 25th May, 1772.

In 1776, Colonel Phillips was serving in Canada with the Army under Lieut.-Generals Sir Grey Carleton and Burgoyne, and at the Battle of Skenesborough near Ticonderoga and Mount Independence, North America. His Major of Brigade (Captain Bloomfield, R.A.)

---

[1] "Superlative practice on *our* right, by Captain Phillips," says Mr. T. Carlyle, describing the effect of the British Artillery at Minden. It does not appear to be generally known that the "unsurpassable Six," the 12th, 20th, 23rd, 25th, 37th, and 51st Regiments, attacked the 10,000 French Cavalry which formed the centre of their line, by a misunderstanding of their orders, Prince Ferdinand's order was "Attack *on sound of* drum." This, by mistranslation no doubt, was taken to mean, "Attack *by sound of* drum,"—drums beating. Off they strode, without delay, "to the horror of their Hanoverian comrades, who nevertheless determined to follow as second line." The French Artillery, "Battery of 30 guns on one flank, of 36 on the other, does its best upon this forward-minded Infantry, but they seem to heed it little; walk right forward; and to the astonishment of those French Horse and of the whole world, entirely break and ruin the charge made upon them, and tramp forward in chase of the same. The 10,000 Horse feel astonished, insulted; and rush out again, furiously charging; the English halt and serry themselves; 'No fire till they are within 40 paces;' and then such pouring torrents of it as no horse or man can endure. Rally after rally there is, on the part of those 10,000; mass after mass of them indignantly plunges on,—again, ever again, about six charges in all;—but do not break the English lines: one of them (Regiment Mestre-de-Camp, raised to a paroxysm) does once get through, across the first line, but is blown back in dreadful circumstances by the second. After which they give it up, as a thing that cannot be done." . . . . Contades, the French General, afterwards said bitterly:—"I have seen what I never thought to be possible,—a single line of Infantry break through three lines of Cavalry, ranked in order of battle, and tumble them to ruin." Carlyle, "Frederick the Great"; V., 450-1.—*H.W.L.H.*

[2] Phillips was attached to the English Cavalry Brigade, under Lord Granby, which had to trot near five miles to enable it to take part in the action. His fire (across the Diemel) was so severe that the French retired "with the utmost precipitation." "Gentlemen's Magazine,"; XXX., 387. "Captain Phillips," says an eye-witness, "brought up the English Artillery at a gallop, and seconded the attack of the Cavalry in a surprising manner." "Operations of the Allied Army, 1757 to 1762, under H.S.H. Prince Ferdinand," by an Officer of the British Forces: London, 1764, *ad. loc.* Phillips' conduct on this occasion has called forth the praise of a generous enemy, the Marquis de Ternay; "Traite de Tactique,"; I., 601. In leading this attack, at the head of his own Regiment, the Blues, Lord Granby "had his hat blown off, a big bald circle in his head rendering the loss more conspicuous. But he never minded, and stormed still on." "Mauvillon, in Carlyle; VI., 44.—*H.W.L.H.*

was wounded, and Captain Green, 31st Regiment, his Aide-de-Camp, was killed. The Artillery in this action was very numerous.

Colonel Phillips did not succeed to a majority in the Regiment until 25th April, 1777, while on the 29th of August of the same year he attained the rank of Major-General in the Army.

In the action of Still-water, near Saratoga, 19th September, 1777, Major-General Phillips commanded the left wing of the Army; and it is recorded that in one instance during the battle, his presence of mind had nearly saved the Army, when at the most critical point of time he restored the action by leading up the 29th Regiment.[1]

At Saratoga, October, 1777, he conducted the retreat and was the second senior at the Council of War, 13th October, when, from the strength of the Army, General Burgoyne was obliged to surrender to the Americans.[2]

The last promotion of Major-General Phillips was that of Lieut.-Colonel in the Regiment, bearing date 6th July, 1780.

In 1781, Major-General Phillips was attached to the Army, under Lieut.-General Sir Henry Clinton at New York, and proceeded with 2000 men, the *elité* of the Army under his command, on the 20th March at Rhode Island, to prevent the French troops sailing for the Chesapeake. The troops were frequently engaged both with the enemy on land and the shipping, but in May following the General was seized with a fever, which deprived the Army of his abilities, although he continued to travel with it. Unfortunately for his army, General Phillips' disorder proved too strong for the power of art to remove, and he breathed his last at St. Petersburgh the 13th May, 1781.

In him the King and his nation lost a most excellent Officer.

---

[1] This was the battle at which a Battery under Captain Thomas Jones, with Lieutenants Hadden and Reid, was so distinguished. Jones was killed, and *all* the N.-C.-O.'s and men were killed and wounded, except *five*. "Hist. of the American War," by C. Stedman; London, 1794; I., 338; "Hist. of the War with America &c., by J. Andrews, LL.D.; London, 1786; II., 403, 404. See also Duncan's "Hist. of the Royal Artillery," *ad. loc.*; and a paper on Phillips in the "Proceedings, R.A.I.,"; IV., 248.—*H.W.L.H.*

[2] It should be remembered to the honour of the American General, Gates, that he refused to permit his soldiers to witness the humiliation of the English as they piled their arms. See Stedman, *ad. loc.*—*H.W.L.H.*

BATTLE FIELDS

IN THE

LE MANS CAMPAIGN.

BY

CAPTAIN R. F. JOHNSON, R.A.

No. 7.

PARIGNÉ L'EVÊQUE.

10th January, 1871.

To reach Parigné l'Evêque take the steam tramway from Le Mans, which runs alongside the high road to Grand Lucé and La Chartre.

After leaving Pontlieue, with its memorial of those who fell only to prove the uselessness of a struggle continued with simple numbers against organization and discipline, the road ascends through gardens and orchards to the top of a flat ridge crowned with a large fir forest. Just over the crest, where the rails make a slight detour to avoid the steepest part of the descent (5°) into the flat country to the south-east, the Chemin-aux-Bœufs is crossed, a sandy track which marked the front of the main French position on the right of their line. From this point everything is hidden by trees on either side of the road, but the track stretches out in a straight line for six miles to Parigné l'Evêque. The country much resembles that to be found on the outskirts of the commons round Aldershot. The soil is sandy, and its natural products are firs, heather, and rank grass; but numerous small farmers have carried on a war with these, and have succeeded in establishing orchards and a few arable fields divided from each other and from the larger portion that is still unreclaimed by small banks and hedges.

At Changé tram-station is the cross-road marking the German front on this part of the field, the Chateaux de Chef Raison and de la Paillerie being hidden in timber a little to the east. No attempt was made, or could be made, to advance along the road itself, for it was swept by

three mitrailleuses supported by two heavy guns in rear of them on the slope of the main position. On the 11th January, however, some troops pressed forward on either side, and in the rough ground north of the road the French made an unexpected attack on the right flank of the Germans, who lost forty-two prisoners: an example of the dangers to which the offensive is liable in such an enclosed and thickly-wooded country.

Parigné is reached in an hour from Le Mans. It is a large village (3300 inhabitants), built on the broad end of a high ridge which runs in a south-westerly direction from it. The buildings which are all of masonry with tile roofs lie, with the exception of one row of houses, to the left of the high road which ascends a steep hill to the south-eastern entrance, curving slightly southward in its course. Beyond the village the road is flat for 200 yards, and then bending eastward again ascends gently to Le Breil Chateau, which is surrounded with trees.

South-east of the village the high ground is continued by a *col* to another high broad ridge running to the north-east, beyond which is the valley of the Narais river. No view can be obtained of the low ground east of the village on account of the trees, so it is best to proceed at once to this last-named high ground, crossing the valley by the new road leading from the cemetery in the middle of the village to the farm Les Laires. On the brow of the hill on left (N.) of the road in the line of hedges just in front of Les Laires an excellent view is obtained.

Facing west, a small amphitheatre about 1000 yards in diameter lies below you, divided into small cultivated enclosures, but with so much timber in the hedge-rows as to have the appearance of a forest. This amphitheatre has on the west a broad opening in its surrounding hills, but they are otherwise continuous. On the south-west is the end of the Parigné ridge covered from top to bottom by the village, to the east the high ground you are on, to the north the southern end of the long ridge covered with the Loudon forest, while the gaps are filled by low but well-defined *cols*, over which pass good country roads to Challet (E.) and Ardenay (N.).

On a clear day, looking west, the horizon is bounded by a long line of grey hills which are far beyond Le Mans, then comes the line of heights surrounding that city to the east and north, at the end of which can be seen the cathedral roof, just showing over the low, dark fir-clad ridge which marks the main French position, and bounds the low, flat country west of Parigné.

The centre of the amphitheatre is flat, but the small brooklet, which bounds the eastern edge of the village, runs in a narrow strip of meadow ground rather lower than the rest of the "arena." The farms are hidden by the trees; Corps Lévé lies at the end of the Loudon forest ridge, La Hellerie in the middle of the amphitheatre, a chimney of Les Blinières peeps out amongst the trees in the hollow 600 yards on your right front, and a house of Les Boutinières can be seen 1000 yards distant on your left rear.

On the 10th of January when morning broke it was snowing hard, and the cold was intense. Parigné had been evacuated the evening before; but between 4.30 a.m. and 9·30 a.m. the French had again occupied it with about 2000 Infantry, 6 guns, and 6 mitrailleuses.

The guns, by dint of covering the road (which is macadamized, not paved) with sand and manure, were got up the hill and posted at the top (S.E.) end of the village, while the mitrailleuses were excellently placed, protected by walls and buildings, at its north-east entrances.

A German Division on the left of their centre column had bivouacked in the valley of the Narais, four miles to the north-east, with outposts consisting of one battalion, one squadron, and some pioneers on the hills north-east of Parigné, and having a picquet at the end of the Loudon forest at Corps Lévé. As Parigné was reported evacuated it was intended to move directly on the French main position at Changé, but when the first troops were commencing their march news arrived that the enemy was again at Parigné, and displayed too aggressive an attitude to be left on the flank of the advance.

At 8 a.m. musketry is heard near Corps Lévé; it is the French attacking the picquet there, and so opening the game. At this time the Germans have brought up to Les Braults, on the *col* east of the Loudon forest, 2 battalions, 3 squadrons, and 6 light guns. One battalion advances on the west of the Ardenay road and, driving in the French skirmishers, occupies La Hellerie, while the outposts descend from the amphitheatre and seize the various farm buildings.

After a time, skirmishers issue in considerable numbers from the south-east of the village, and appear as if about to attack the German left, but some reinforcements for the latter are slowly arriving, and no real advance is made.

At 11 a.m., unexpected help reaches the French in the shape of 3 battalions, 4 guns, and 3 mitrailleuses coming in from the south, and one of the battalions joining the skirmishers on their right their attack becomes very menacing. The Germans now hold Les Blinières strongly with three-quarters of a battalion, and have three battalions spread along the rest of the line, while seven guns are firing on the village from the *col* near Les Héraudières on your right. As the troops are required to fight again to-day at Changé, and it will not do to cause them too much fatigue or loss, the fight on the German side becomes a passive defence in expectation of reinforcements from the east, who will turn the enemy's right.

At noon, anyone on the French side would think that the defence is successful, and this important post on the flank of the German advance secure for the present, but a fresh German battalion has occupied Les Boutinières, while another with some guns moves along the *col* towards the south-east of the village, and the battery playing on it from Les Héraudières is made up to 21 pieces.

Days are short and Changé five miles distant, so at half-past twelve it is decided to finish the business in hand quickly. It is not, however, easy, for, although the French guns are outnumbered, the mitrailleuses protected by garden walls and buildings sweep every approach with their deadly shower of bullets. Nevertheless, one battalion from Les Boutinières working round to the south, and $2\frac{1}{4}$ battalions from Les Blinières made a bold rush and penetrate into the south-east part of the village, capturing some guns and mitrailleuses. The French make a gallant charge to re-capture the mitrailleuses, fighting desperately,

but the Germans are heavier, and in a little time their guns have advanced into the village and are pounding away down the high road at the masses of fugitives flying westward.

The trophies are 2000 prisoners, 3 mitrailleuses, 2 colours, and some wagons. The victors, leaving 1½ battalions as garrison, march away to fight again at Changé.

If there is time, it is worth while to make a detour on the way back to the tram station, in order to see the details of the ground, which, in the midst of these small enclosures, are hidden at a little distance. Follow the new road past Les Laires, turn with it once to the right, and then take the first turn to the left along a small lane. On the right will be seen the Narais valley, and to the north the woods of Ardenay. Take the first turn to the left again, and continue west until the Ardenay road is reached. The Artillery position is passed on the right: it will be seen how the ground enabled the guns to shell the village with no annoyance to their own troops stationed in the low ground. Turn to the left along the Ardenay road to the village, where the suitability of the entrances for the action of mitrailleuses is clear. The tram station is quarter of a mile west of the church.

(To be continued.)

THE SERVICES

OF THE LATE

GENERAL P. V. ENGLAND, R.A.

BY

MAJOR H. W. L. HIME, R.A.

Secretary, R. A. Institution.

WITH General England's death, the race of our Peninsular Officers has become extinct: he was our last. He has unfortunately left behind him no notes or correspondence of any description relating to his services; and the following meagre account of them is from his "Statement of Service," kindly lent by the D.-A.-G., R.A.:—

He took part as 2nd Lieutenant in the Expedition to the Weser in 1805–6 under Lord Cathcart. As 1st Lieutenant he served in General Craufurd's Expedition to the Cape of Good Hope and South America, 1806–7. Finally, he was at the Battle of Vittoria and the Siege of San Sebastian. He possessed the Peninsular Medal and 2 Clasps.

His first Commission was dated 10 May, 1805. He became 2nd Captain on Half-Pay in 1817; 2nd Captain on Full-Pay, 1823; Lieut.-Colonel in 1843; Colonel in 1854; General in 1873. He held the position of Master Gunner, St. James' Park, from 2nd August, 1880, until his death, 6 November, 1884.

A BRIEF

DESCRIPTION OF OLD FOUGASSES

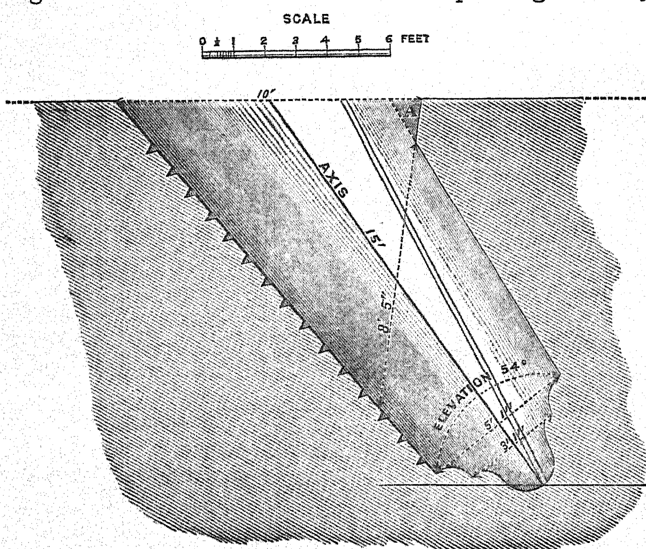
DUG IN THE SOLID ROCK ALONG THE

COAST OF MALTA.

BY

LIEUT. A. SAMUT, Royal Malta Fencible Artillery.

Towards the year 1760, a general feeling of uncertainty and panic spread itself rapidly through the Island of Malta, owing to a fearful conspiracy being discovered amongst the Mahometan slaves retained in the Island, their ringleader being the Turkish Pasha of Rhodes, then a prisoner of war in Malta, and in aid of whom a Turkish Fleet was to have visited the Island. This at once revived the old fears of an Ottoman invasion; and the Grand Master (then Emanuel Pinto) issued orders for the fortifications to be inspected and enlarged, and everything to be done in order to avert the impending calamity.



Vertical Section of an old Fougasse, dug in the solid rock on the shore of "Birzebbugia," Malta.

Amongst the great variety of works for coast defence which were then constructed, a number of very large Fougasses were excavated

in the solid rock along the accessible part of the coast, within a short distance from the sea, and covered by intrenchments and other works in rear. The shape of these Fougasses is that of an inverted cone with an elliptical or circular base, their elevation varying from 40 to 60 degrees. And where the ground does not afford sufficient solidity at the mouth, on account of a very sharp acute angle being formed, the circumference is broken in rear, and arched as shown at A in the sketch. Holes are cut down their side, which act as steps and afford access to the powder-chamber, which is hollowed out at the bottom. A barrel of gunpowder is placed in this chamber and a wooden board put over the barrel to cover the whole and close the bore; a great quantity of stones are then spread over the board so as to fill the Fougasse to the very top. The stones are thrown to a distance of many hundred yards, and work dreadful havoc amongst the enemy, being capable not only of killing men but of breaking to pieces and sinking boats. A groove about two inches deep runs perpendicularly along the interior of the Fougasse from the mouth to the powder-chamber, a strand of quickmatch placed into it conveying the flash to the charge, which is thus ignited.

The impossibility of directing them renders their effect less certain, hence the mouth of the Fougasse is usually turned to the weakest point of the coast. The sketch gives the general dimensions of the Fougasses and illustrates their construction.

RECENT GUNNERY.

BY

MAJOR G. MACKINLAY, R.A.

THE introduction of high velocity guns, and the consequent re-armament at present being carried out in our service, has aroused public interest in Gunnery; and those who have lectured or written within the last few months have found many hearers and readers.[1]

Experience in the manufacture of the new ordnance has accumulated, and the production of high-velocity guns of the smaller natures for the Royal Navy is now considerable, though the larger ordnance are being produced with greater deliberation. It is proposed in the following article to glance at a few new features in Gunnery.

With regard to gun construction, it was stated by Lord Hartington, last March, that "during the past two years we have been undergoing a double transition; first, from the muzzle-loader to the breech-loader; and, in the next place, in the material, from wrought-iron to steel."

Whatever may have been the relative advantages of breech and muzzle-loading a few years ago, it seems now to be universally admitted that the present conditions of very long guns with large diameter chambers, slow-burning powder, and the need for preventing the ready movement of the projectile, by holding bands, all compel the employment of breech-loaders. Taking advantage of the experience of the continental nations in breech-loading, we have adopted the principle of the interrupted screw, long used by the French (with certain modifica-

---

[1] *Vide* Colonel Maitland's lecture at the Royal United Service Institution on "The Heavy Guns of 1884": a second day was devoted to the discussion. At the same place Colonel Brackenbury took up the closely allied subject of Gunpowder. Colonel Hope, V.C., explained his system of gun-making, which is shortly to be tried by the Government; and Captain Lord C. Beresford, R.N., has brought forward the need for Machine guns. The Institution of Civil Engineers has devoted two evenings to Mr. Longridge's paper on "Wire Guns"; and a valuable mathematical treatise on the same subject has lately been published. With regard to the effects of fire, Captain Orde Browne read a paper, at the Annual Meeting of the Iron and Steel Institute, on "Armour, and its Penetration by Projectiles"; while Colonel Baylay, R.A., has lately lectured at Chatham, to the Royal Engineers, on "The results obtained during the last few years of experimental firing at siege works at Lydd."

The recent report of the Gun Foundry Board, by officers of the United States Army and Navy sent to Europe, gives valuable information about the manufacture of Steel for ordnance. The pages of the "*Engineer*" continue to furnish reports of home and foreign gunnery experiments, together with sound deductions; while "*Engineering*," the new "*Illustrated Naval and Military Magazine*," &c., have devoted articles to the same subject.

tions of details), and the "de Bange" system of obturation. This breech-closing gear has the advantage of being well protected, as it is behind the gun, and the obturating apparatus is not readily damaged by rough usage or by grit; and the durability of the apparently frail wad is remarkable. At the Okehampton practice in 1883, several spare wads per gun were taken, but no extra ones were found to be necessary. The American officers remark, however, that it entails a slight addition of length to the gun, which is of course a disadvantage: it was at one time remarked, as a somewhat strange fact at experimental practice, that the breech of a heavy gun fitted with this obturation was hard to open at the first round or two, but it worked easier as the firing went on. The flat steel cup employed by Armstrong to prevent escape of gas at the breech, gives good results if carefully attended to, but if grit, &c., gets in, it is liable to damage, and it is expensive; it is consequently not generally considered so serviceable as the "de Bange" method of obturation.

The change from wrought-iron to steel has been brought about by improved methods of manufacture of the latter, which may now be said to surpass wrought-iron in all its good qualities as a material for gun making, though great attention and skill are necessary to overcome all the difficulties which still arise in manufacture. Large masses of steel require the greatest care in their production and manipulation in order to secure uniformity and soundness; this accounts for the fact that the long tubes for the first 100-ton guns were made in two parts instead of in one piece, as is always the case with other ordnance. Larger ingots seem to have been cast and worked on the Continent than in England: nevertheless, the American officers, after going over the chief French and Russian works, decided in favour of Whitworth's processes, particularly commending the method of slow pressure by hydraulic power instead of the ordinary forging under a steam hammer.

Notwithstanding the difficulties in steel manufacture, Krupp is now making four guns of 121 tons for the Italians; and Sir W. Armstrong, Michell & Co., three of 110 tons for our own Government.

With regard to methods of construction, the coils of wrought-iron have given place to so-called hoops, which are first bored, or rather trepanned, from a solid ingot, which is cut up into lengths, and each is then enlarged by heating and hammering on a mandril thrust through it and supported at both ends: the inner tube is covered by a breech-piece, which is drawn out under the hammer and bored. The parts are then shrunk together. An important improvement (Fig. 1) lately introduced into our service, is to cut the screw-thread for the reception of the breech-screw in the jacket or breech-piece, and not, as was at first done, in the A tube itself: as it is found that the latter has quite sufficient work imposed upon it in resisting the immediate action of the fired gunpowder in a transverse direction; when the screw-thread is cut into the A tube, a longitudinal strain is also imposed upon it.

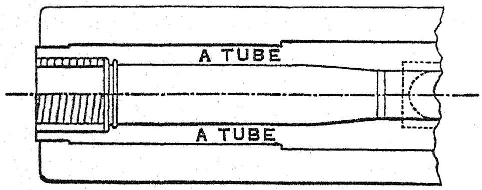
Provision is generally made for boring out a gun to a slightly larger diameter, in order to insert a thin lining of steel when the original bore has become too much eroded, by continued firing, to give

the proper amount of rotation to the projectile; gas-checks and Vavasseur driving-bands, which prevent windage, have checked the

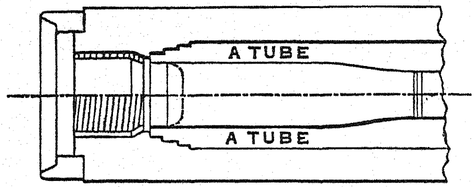
FIG. 1.

Breech Part of 4-inch R.B.L. Gun.

Old Pattern with Interrupted Screw cut in A Tube.



Present Pattern, Mark III., with Interrupted Screw cut in Jacket.



SCALE $\frac{1}{12}$TH.

tendency to erosion to a very great extent; but, on the other hand, the very large charges now employed still tend to produce this injury, particularly in the larger natures: it cannot at present be definitely estimated how many rounds a gun may fire before this operation becomes necessary.

The present methods of construction give considerably greater strength than the system of wrought-iron coils: but critics are not wanting who advocate the making of even stronger guns without increase of weight. The plan which seems to promise most success in this direction is that of winding steel wire (which can be made of very great tenacity) round an inner tube of steel; though Mr. Longridge advocates the employment of a thin inner casing of cast-iron, as it has a low modulus of elasticity; longitudinal strength has to be provided for in other ways, and the wire consequently only constitutes a rather small part of the total weight of the piece. The advantages of the system are (in addition to the enormous strength of the material) that the wire can be wound on at any desired tension, and thus the amount of the compression, given to the inner tube can be accurately adjusted, and the strain on firing fairly borne by the whole thickness of the piece: but it appears to be a little difficult to determine what is the best practical tension to employ in laying on the wire; Mr. Longridge's book is full of calculations on the subject, and a glance through its pages shows that it is no very simple matter. Sir W. Armstrong, and others, have made ordnance on this plan, which have given good results; but Schultz, in France, designed one which unfortunately broke at the first round, as the longitudinal strength was not sufficient. Experience alone can fully decide the merits of this system; the

general opinion, however, appears to be that it will probably give good results when well matured.

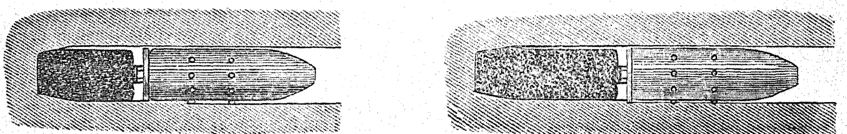
The advocates of stronger guns urge that even higher velocities than those now reached should be attained, but it is a question if we are not already near the practical limit of muzzle velocity; for if more is given the resistance of the air increases greatly and soon reduces the velocity, recoil of the gun is augmented, and when firing at "hard" armour it will be difficult to find a material for the projectile which will not break up, in fact even now it is difficult to do so: on the other hand, even if the projectile falls to pieces on impact, an increased velocity produces greater damage on the armour; and the flatter trajectory, which high velocity always gives, is greatly conducive to accurate shooting.

The sealing of the windage, by gas-checks, in the R.M.L. guns has led to some curious results; at first, as might be expected, the ranges were considerably increased, as leakage of the expanding powder-gas was prevented; but when Mark II. gas-checks with projections were issued, the ranges fell off greatly—as much as 150 yards in 1200 yards, and other ranges in proportion. A little consideration makes the reason plain: with the service "full" charge for, say, a 10-inch gun, the studs (Fig. 2) go nearly to the ends of the grooves, and the base

FIG. 2.

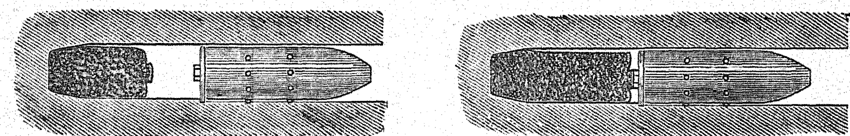
10-inch R.M.L. Gun.

Full Charges. Battering Charges.



With Mark I. Gas-check.

Scale $\frac{1}{36}$th.



With Mark II. Gas-check.

of the projectile, or rather the smooth Mark I. gas-check attached to it, just touches the cartridge; but with the Mark II. gas-check the projections on it cause the projectile to be stopped some 10 inches short of its former position, and thus there is an empty space between the cartridge and the projectile, altering the gravimetric density of the charge considerably. Calculation by Noble and Abel's Table of Expansions (*vide* "Text-Book of Gunnery," 1883) of the effect on muzzle-velocity, and consequently on the range, agrees fairly well with the results actually attained, but it is evident at a glance that there must be *some* falling off in muzzle-velocity, for the pressure of the

powder-gas only acts in the bore for some 9 feet 2 inches, whereas in the former case it acted over a distance of 10 feet. With the battering charge, however, scarcely any difference in range is noticed, whether Mark I. or Mark II. gas-check is used; and this, too, is evident from Fig. 2, in which it appears that the long cartridge itself stops the projectile in each case at about the same spot. As increased charges have been used with the heavy muzzle-loaders, it is evident that their range-tables have fluctuated a good deal of late years from several causes.

Powder.

Much as guns have changed of late, gunpowder has altered nearly as much: in fact it may almost be said that a change in one calls for a corresponding change in the other. Mr. Longridge quaintly complains that we are returning to the gunpowder of the Chinese, so much is required for a gun and so slowly does it burn; the present kind of powder is designed to give a low maximum pressure long sustained as the readiest way of attaining very high velocity in a heavy gun; this involves the use of very large charges, and it is quite possible that ere long equally high velocities may be attained by smaller charges, either by improving the quality of the powder, as has lately been done with cocoa powder, or by making the guns stronger and able to bear more than a low maximum pressure, in which case the powder would again be made to burn more rapidly. As an instance of the present altered conditions, we may quote from Colonel Maitland's lecture, "that powder for the new breech-loaders was asked for which, with the usual charge, would only give a M.V. of 800 f.s., and 5 tons pressure in the 38-ton R.M.L. proof-of-powder gun"; this was supplied, and under the altered conditions of a breech-loader with a holding-band on the projectile, which prevented motion till a pressure of one or two tons per square inch was developed, the M.V. was 1560 f.s., and the pressure rose to 15 tons on the square inch.

The behaviour of powder charges is judged of in a very systematic, if not perhaps rigidly scientific manner, by means of the crusher-gauge, which furnishes valuable comparative results: not only have these been inserted at various parts of the proof-gun, but they have been attached to the breech-screws of breech-loaders, and to the bases of projectiles; and it is now usual, at the proof of powder in a heavy B.L. gun in the Royal Arsenal, to place a crusher-gauge inside the cartridge; it is not blown out on firing, but it is generally found afterwards at or near the chamber, and so hot that it cannot be held in the hand. A plan has lately been adopted to find how the velocity of "free recoil" of a gun is increased at short intervals at the beginning of recoil, and hence the pressures in the bore at various parts have been deduced.

It appears, as the result of careful experiment and observation, that it is not possible to produce powder of different brands identical in quality, as variations in atmospheric conditions, &c., during manufacture, and when stored, cause considerable differences: blending different brands together, in order to obtain a large quantity of uniform quality has been tried with some success.

Rapidity of Fire, Recoil, &c.

Various circumstances have called for extreme rapidity of fire under certain circumstances, and the long talked-of question of magazine rifles may ere long take practical shape in our service; but machine guns have already established themselves, specially in the Royal Navy; not only are the loading arrangements conducted with great rapidity, as the projectile, powder-charge, and means of ignition are all together, as in a small-arm cartridge, and simple movements load, fire, and extract the old cases; but the mounting practically prevents recoil, though the guns sometimes shift round laterally a little on firing; loading and laying thus becomes very rapid. To go to heavier pieces, the Vavasseur mountings of 4-inch to 6-inch guns allow very little recoil, and the guns regain their old positions at once after firing with little deviation from their original directions, thus causing the laying to be very quick. With the new B.L. field guns, powerful frictional breaks are attached to the naves of the wheels, preventing the otherwise excessive recoil, which would cause delay in firing, on account of the time required for running-up a considerable distance.

The great increase of charge and muzzle velocity in the new B.L. field gun has led to a device for modifying the rapidity of the blow which the recoil of the gun inflicts upon the carriage; the trunnions of the gun rest in bearings at the ends of two strong arms, whose lower ends pivot round the axletree, the breech is attached to the elevating gear in such a way that when the gun is fired it moves back and rises a little with a kind of parallel motion, when the trunnion-arms come in contact with strong spiral steel springs on the carriage, which force them and the gun forward again; the blow on the carriage is greatly modified by a steel hydraulic buffer attached to the breech and to the axletree, the piston-rod is drawn out on firing, and, opposing the recoil of the gun, gradually communicates motion to the carriage, and prevents the sudden breaking strain which would otherwise occur; this carriage has been well reported on at Okehampton, and at Shoeburyness it has been found to be conducive to good shooting.

The amount of recoil of a small-arm is practically limited[1] by the amount of blow on the shoulder which an ordinary man can sustain repeatedly without lessening his accuracy of aim. As this depends on the momentum of the bullet and powder-charge, $\frac{WV}{g}$, it follows that if very high velocity is required, the weight of the bullet must be reduced; since WV being constant if V is to be increased, W must diminish; but if the weight of the bullet is lessened its diameter must be made less, or otherwise the retardation of the air upon it will be increased. The new rifle for the Service carries out this principle, as the velocity is greater than with the Martini, and the bullet is lighter than the present one; but as the bore is small, the "sectional density"

---

[1] Unless, indeed, any arrangement be devised to cause the blow to come with less suddenness on the man's shoulder, on the principle of the elastic field carriage; but it is hardly likely that anything of the kind will be necessary.

is good, and thus the resistance of the air is not able to exercise a great retardation, the velocity is well maintained, giving rise to a very flat trajectory which aids so greatly in accuracy, as mistakes in judging distances become of less importance. The practical limit preventing a still further reduction of bore seems to be that difficulties are apt to arise with lubrication, and fouling occurs more readily. This rifle is said to be the best military small-arm in the world. It is to be hoped that all details will soon be settled, and that it may shortly be issued for service.

Accuracy of Fire.

The flat trajectory of the modern high-velocity gun tends to accuracy, and efforts are made in a variety of ways to attain good shooting. The Commandant at Shoeburyness, in reviewing the annual practice returns of batteries, has often pointed out that range-tables are only to be taken as general guides, and they must not be followed blindly, but corrections should be made from observing results at the time of firing. The new addenda to the "Manual of Naval Gunnery," just published, affords useful help, in a table which shews the comparative influence at various ranges of the principal causes affecting accuracy of fire from rifled guns, the causes being variation in muzzle velocity, in jump, a strong wind, alteration of barometric pressure, and mistakes in judging the range; thus at 2000 yards with the 4-in. B.L. Gun, Mark II., an alteration of 50 f.s. in M.V. will change the range by about 72 yards, and will alter the point of impact on a vertical target by 12·5 feet, while 5 minutes change in "jump" will alter the same 50 yards and 8·1 feet respectively. A gale of 50 f.s. in the direction of the firing will alter the range by 28 yards, and the vertical height of impact by 4·9 feet, while a difference of 1 inch of barometric pressure will make differences of about 22 yards and 3·8 feet in each case; and a mistake of 100 yards in judging the range will cause the projectile to strike 17·3 feet above or below the expected point.[1] Range-tables are now becoming more full; the angle of descent and the dimensions of the 50 p.c. probable zones at various ranges being frequently given; the amount of variation[2] in muzzle velocity which may be expected from various brands of powder is also sometimes furnished.

The complaint is frequently made that the complication of the machinery, &c., now employed in working guns, opens a door to endless mistakes, and there is considerable truth in this assertion. However, as this complication exists, it is practically useful to watch for the mistakes which may occur, as thus they may be avoided; and, on the principle of the Insanitary House at the Health Exhibition, a list of errors frequently made might usefully be pointed out to prevent their occurrence in future, and to attain accuracy of shooting. Among

---

[1] Addenda, 1884, "Manual of Gunnery for Her Majesty's Fleet." Table calculated by the Assistant Secretary, Ordnance Committee.

[2] The muzzle velocity of the 5-inch B.L. gun with 16 lbs. P. powder has been found to vary between 1830 and 1730 f.s. An alteration of 100 f.s. in the M.V. under these conditions alters the range (roughly) by about 8 per cent.

errors which have been made, and which might occur again unless watched for, may be mentioned the fault of not ramming home a M.L. projectile to its proper place, and thus altering the gravimetric density of the charge, and consequently the muzzle velocity and range of the projectile: in firing with heavy guns and *full* charges, the tangent-scale for the *battering* charge has, by mistake, been employed, with the natural result that the projectile fell far short of the target. Other mistakes again are likely to arise under certain conditions, and arise as much from weakness of a system as from personal errors; as, for instance, when two men take a range and each observes a different distant object, when they believe they are looking at the same; the simple effect of a shower of rain in lessening friction has altered the resistance of an Elswick compressor, previously adjusted by experienced gunners, to such an extent that delay in continuing the firing has taken place.

For a long time it seemed doubtful if range-finders would find a permanent place in our service, some officers reported favourably, while others again found little good in them; but improvements having been made in cheapness and portability, and more experience in their use having been gained, they now seem to be fairly established in our own and in continental armies, and they doubtless greatly conduce to accuracy of shooting under certain circumstances. On the strong recommendation of the Committee on Range-finders, a School of Instruction has been established at Aldershot, with a definite course, and thorough practice in the use of the Watkin instrument, as it appeared that its use was seldom properly understood, and even when that was the case the necessary facility, only developed by constant practice, was not attained. The Committee justly represented that as careful training is required to make army signallers, where those at each end of a range are trying their best to understand each other, so regular training is also necessary in range-finding, where the enemy's constant effort is to conceal what the observer wishes to find out. Astronomers often say that there are plenty of good telescopes in the country, but their full effect is not obtained because there are comparatively so few who have properly mastered the systematic and accurate methods of observation necessary to make good use of them; the same remarks might be applied to range-finders. Care in the use and keeping of these instruments must be insisted on, as sometimes those who use them do not consider that a range-finder should be handled more carefully than a sword or a rammer; the writer well remembers some four years ago, soon after coming in from drill, at Ipswich, finding the Watkin range-finder in its leather case carelessly flung on the litter, outside the stables, and the N.-C. officer in charge could hardly be made to understand that he had not acted properly in leaving it in a place where almost anything might have been thrown upon it.

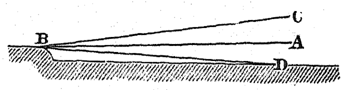
The inventions, experiments, and calculations of Professor Bashforth have supplied a ready method for calculating ordinary trajectories; his plan has been found most useful, and only lately a paper[1] has appeared

[1] By Major W. McClintock, R.A.

in these "Proceedings," giving examples of the use of his tables: Professor Greenhill has also re-calculated an abridged table from Bashforth's data. Krupp has compiled tables on the same plan, giving almost identical results when the difference of the density of the air is taken into account.—*Vide* "*Nature*," 3rd April, 1884.

On the subject of ranges, the question often occurs "how is the range altered by firing up or down hill, or from a height?"; for instance, the other day it was desired to know what would be the range for various quadrant angles of elevation and depression from a battery some 300 feet high. It is generally customary in such cases to assume what is called the "rigidity of the trajectory," as is done in making out ordinary range-tables at Shoeburyness, when the gun is at a certain height above the sands which form the range: for instance, if ABC is the quadrant angle of elevation, and the projectile strikes at D (Fig. 3), which is below the gun, the real angle of elevation is DBC;

FIG. 3.



and it is assumed that if firing over a horizontal plane with a quadrant elevation DBC that the range would be the same as actually observed; although this is not strictly true, it is a close approximation, unless the ratio of height to range becomes considerable. This subject was fully investigated some years ago in the *Revue d'Artillerie*.

Accuracy of fire has been sought for by improved methods of sighting, as with the small hole and cross-wires with the new field guns; other details connected with sighting and laying have been added, as deflectors and longer deflection bars, and the rack-and-pinnion method of running-up the tangent-scale in some of the newer guns is rapid and convenient.

Projectiles.

For armour-piercing purposes, forged steel is the best and strongest, but it is very expensive, and chilled projectiles of good construction have lately given good results when fired at compound armour. Steel has been tried for some common shells, since the walls can be made thinner, and, consequently, a larger bursting-charge can be inserted: by lengthening shells and compressing the powder, it has been found possible to more than double the bursting-charge; thus with the 6-inch gun the bursting-charge in the ordinary cast-iron common shell is under 7 lbs., but long steel ones have been made holding 16 lbs. of compressed powder; this increase is a most important matter when destroying earthworks, &c.

Steel has also been employed for shrapnel shell, of which the newer natures have the bursting-charge in the head instead of the base; Mr. Delmard's tubular steel has been employed for the body of 7-pr.

shells, in which the percentage of useful weight is 45·4, while the ordinary percentage in other natures is 25 p.c., and often much less.

The distribution of weight in projectiles is a matter of importance as, doubtless it greatly affects the accuracy (especially at long ranges). The new B.L. projectiles drift less than muzzle-loaders; the comparative smoothness of their studless surfaces is supposed to account for the decrease.

Penetration.

Italian experiments at Spezzia with the 100-ton gun, in 1876–77, demonstrated the superiority of steel over wrought-iron plates: compound armour has an advantage on account of its hard face (harder than that of a target entirely of steel), which breaks up the projectile, and its tough back of wrought-iron tends to hold the plate together after it has been struck. Very good estimates can be formed beforehand, by calculation, of the probable penetration of wrought-iron armour by projectiles moving at given velocities, if the plate is of ordinary quality; but the resisting power of compound armour is difficult to foretell; the writer remembers, at a recent experiment at Shoeburyness, when the 80-ton gun was fired at a 19-inch compound plate, that even the most experienced declined to prophecy before the event. In a general way the amount of damage appears to depend upon the total amount of "energy" in the projectile, almost irrespective of calibre,[1] and the resisting power of the plate seems to be more nearly proportional to its weight than to its thickness, as the blow is more or less distributed over the whole mass, and is not localized as with wrought-iron: the backing has a very great influence on its resistance, a rigid unyielding one being best, as it has been found that solid granite has given most excellent results, greatly preventing local deformation at the point of impact; on the other hand, a soft backing, such as wood, or even iron girders which are liable to bend unless very massive, allow the plate to bulge where struck, when cracks rapidly appear, extend over a great portion of the plate and quickly lead to its destruction; it would thus appear that the new armour can be more advantageously employed on land defences than on ships, though it must be stated that it is difficult to construct a target representing part of a ship's armour with exactly the rigidity and strength derived from the neighbouring plates and from the whole framework of the vessel on which it is built. The method of attachment of the armour to the structure to be defended is of importance, as it was found in several experiments that large masses fell down when plates held on by only a few bolts were cracked through; they would have given good protection had they been held up in their places, even though detached from the rest of the armour; on the other hand, each bolt-hole weakens the armour to a certain extent. The union of the

[1] It appears, however, that if the velocity is very high, no known material can be made strong enough to hold together, on impact, against steel-faced armour.

two materials, steel and wrought-iron, probably leads to complication and uncertainty in results, and the experience in the manufacture and employment of compound armour cannot yet be said to have arrived at any very complete or perfected stage.

With regard to the penetration and destruction of earthworks,[1] the conditions are different, as high velocity is *not* generally an advantage; under such circumstances common shells of cast-iron often break up on impact, while even steel ones of increased strength will not unfrequently fail in the same way; in addition to this, the high-velocity projectile striking at a small angle with the horizontal is more likely to glance or ricochet than a shell which reaches the earthwork from the same range with a lower velocity and consequently greater angle of descent. In firing at an earthwork with a high-velocity projectile, the first round or two generally penetrates well into the exterior slope if it is fairly steep,[2] but its course in the earth is very erratic, and it *may* turn upwards towards a line of least resistance and get clear out before bursting. As the firing goes on and the breach grows larger with sides of loose gently-sloping earth, the shells tend to ricochet at nearly every round, and it is only by the use of a very quickly-acting percussion fuze that any appreciable quantity of earth can be displaced. For work of this kind it appears that for a given weight, a howitzer with large bore and consequently having a shell of large capacity, though with low muzzle velocity and inferior accuracy, is preferable to the smaller bore with smaller capacity shell, though with higher muzzle velocity: in other words, it is better to have a large proportion of gunpowder in the bursting-charge of the shell but not so much in the cartridge in the piece. The annexed table, giving average results obtained at Lydd, states the same thing in tabular form:—

Name of piece.	Weight of piece.	Weight of cartridge.	Weight of bursting charge in shell.	1200 yards.		2400 yards.	
				Striking velocity.	Cubic yards of earth displaced	Striking velocity.	Cubic yards of earth displaced
	cwt.	lbs.	lbs. ozs.	f.s.		f.s.	
6-inch B.L. gun, Mark II.	81	42 P2	6 6	1552	26	1286	14·13
8-inch howitzer	70	11½ R.L.G.2	14 0	876	46	809	17·6

[1] *Vide* "Experiments at Dungeness and Lydd," by Lieut.-Colonel Baylay, R.A., "Proceedings," R.A.I.

[2] With the object of causing even the first projectiles to glance, it has been proposed to make the exterior slope more gentle than at present.

PRÉCIS

AND

TRANSLATIONS.

FRANCE.

I.

REVUE D'ARTILLERIE.

BY

CAPTAIN A. H. C. PHILLPOTTS, R.H.A.

THE June, July, and August numbers contain a minute description of a method of "Instruction in Shooting for Field Artillery," proposed by H. Langlois, Chef d'Escadron of the 13th Regiment of Artillery.

Owing to the very great difficulties attending the instruction, in laying and firing, of Officers, N.-C. officers and gunners of Field Artillery, actually in the field, arising from the limited area of ground available for guns to manœuvre over, he proposes a systematic and very careful instruction in laying, &c., in quarters.

The following is an example of the method :—

All the Officers, &c., to be instructed are assembled in a room, each being supplied with a prepared form, No. 2. A senior Officer is appointed Director of the Fire, he supplies himself with form No. 1. Suppose the Director wishes to open fire with a shot falling short, he puts a cross to represent the object aimed at, the initial point 0 being the point where the first shot struck. Some officer, previously named to conduct the firing, orders: "With common shell, at 2250 yards, commence firing." He marks this distance on form No. 2, and orders: "No. 1, Fire!" The shot falls at 0 on form No. 1. The Director says "short," and marks the error as over or under on his form. The Officer conducting the firing marks the error on form No. 2, and orders: "No. 2 gun, on the elevating-screw, two turns of elevation." Marks + 2 in the proper column of his form. The Director writes 2 opposite the mark on the scale corresponding to two turns of the elevating-screw, and again signals "short." And so on, until after the 4th round, when the Captain, having obtained the "*fourchette*," increases the elevation by 19 millimetres. After the 11th round, the Captain, having increased the elevation by 5 millimetres, fires a salvo of 6 guns. The Director then draws a line on his form after this. After the 19th round, the Captain modifies the elevation and fires another salvo. The Director indicates this by a line, and so on, until the range is accurately found, which happens in the example before us after the first salvo of 12 observed rounds, that

is, after the 32nd round. The Director then examines the two forms and the remarks he has made during the practice, and explains to all present the errors that have been made. In this case, they would be as follows :—

"After the 4th round, the elevation should have been increased to 20 millimetres instead of only 19. After the 19th round, another half turn of the screw should have been made, and the *fourchette* found to within one quarter," &c., &c.

In order to keep up the attention and interest, all the Officers present take turns in preparing form No. 2. They are, also, sometimes called upon to make observations on the firing before the Director makes his.

The author further recommends the use of six very portable instruments to represent the six guns of a Battery. They are placed on tripods and fitted with sights, elevating arrangements, &c., similar to a gun. They can be carried by a man on foot or mounted.

FORM No. 1.

PRACTICE WITHOUT AMMUNITION OF THE 11TH DECEMBER, 1883.

Class No. 1.

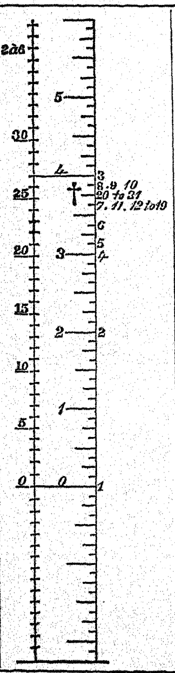
M. A......., Commanding the Class.

Errors in judging.—*Nil.*

Errors in method.—{ *After the 4th shot.* / *After the 19th shot.*

Observations by the Director of the Firing.—*Aim too low.*

A. B......., Director of the Firing.



	No. of Round.	Error in Elevation and Height of Burst.	No. of Round.	Error in Elevation and Height of Burst.	Remarks.
	1	—	26	+	
	2	—	27	—	Measured range:
	3	+	28	+	
	4	—	29	—	Estimated range:
+ 19	5	—	30	—	
	6	—	31	+	First elevation:
	7	—	32	+	
	8	?	33	″	Time of firing:—
	9	+	34	″	1st round:
	10	+	35	″	
+ 5	11	—	36	″	-th round (*fourchette*):
	12	—	37	″	-th round:
	13	—	38	″	
	14	—	39	″	
	15	—	40	″	Average rapidity of firing during the trial shots:
	16	—	41	″	
	17	—	42	″	
	18	?	43	″	Average rapidity after the range has been found:
e + 1	19	—	44	″	
	20	—	45	″	
	21	—	46	″	
	22	—	47	″	
	23	?	48	″	
	24	—	49	″	
	25	—	50	″	

FORM No. 2.

PRACTICE WITHOUT AMMUNITION OF THE 11TH DECEMBER, 1883.

Class No. 1.

M. A......., Commanding the Class.

No. of Round.	Elevation (the first in metres).	Turns of the Elevating-screw.	Error in Elevation and Height of Burst.	REMARKS.
1	2250	"	—	
2	"	+ 2	—	
3	"	+ 4	+	
4	"	+ 3	—	
5	$e = + 19^{mm}$	+ $\frac{1}{4}$	—	
6	"	+ $\frac{1}{2}$	—	
7	"	+ $\frac{3}{4}$	—	
8	"	+ 1	?	
9	"	+ 1	+	
10	"	+ 1	+	
11	"	+ $\frac{3}{4}$	—	
12	$e = + 5^{mm}$	"	—	
13	"	"	—	
14	"	"	—	
15	"	"	—	
16	"	"	—	
17	"	"	—	
18	"	"	?	
19	"	"	—	
20	$e + 1^{mm}$	"	—	
21	"	"	—	
22	"	"	—	
23	"	"	?	
24	"	"	—	
25	"	"	—	
And so on, for the 50th round.				(Signed) ....

GERMANY.

I.

A GENERALIZATION OF SEBERT'S METHOD OF REGISTERING THE VELOCITY OF A PROJECTILE IN THE BORE OF A GUN.

BY

PROFESSOR F. NEESEN.

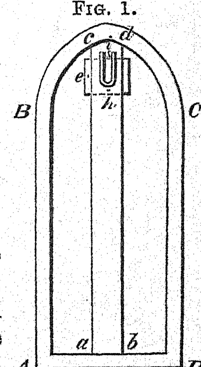
TRANSLATED BY

LIEUT. J. M. GRIERSON, R.A.

IN the following lines I take the liberty of proposing a modification in Sebert's method of determining the velocity of a projectile in the bore of a gun, a modification which at once permits of this method being used to find the velocity along the whole length of the bore.

Mr. Sebert's ingenious method is based on the following principles:—

FIG. 1.



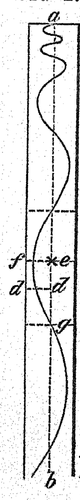
In the projectile (*A B C D*) a bar of metal (*a b c d*) is fixed, coinciding with the axis. On it runs with slight friction, a sliding piece (*e*) which, carries a fork[1] (*h*). On one of the prongs of this fork a writing-point is fixed, which marks the surface of the bar, which is coated with soot or damp lacquer. When the projectile is placed in the bore, the sliding-piece is kept up to the head of the projectile by a knob of metal on the bar (*i*) which is pressed between the prongs of the fork. When the projectile is fired, the inertia of the sliding-piece causes it to remain stationary, while the bar of course moves with the projectile, and when the knob is withdrawn from

[1] The word in the original is "*Stimmgabel*"=tuning-fork.—*J.M.G.*

between the prongs, the fork at once begins to oscillate. The writing-point then describes a curve in the soot or lacquer, from which the velocity of the projectile at different points can be calculated. The number of oscillations of the fork in a minute must be known. When the sliding-piece reaches the base of the projectile, it is held by a catch. The head or base of the projectile can be unscrewed so as to enable the bar to be put in or removed.

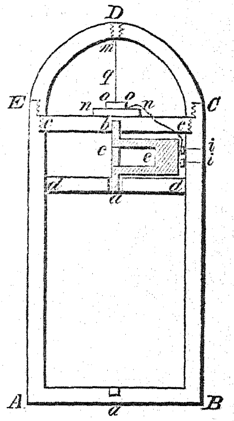
The curve described by the writing-point has the form shown in Fig. 2. At first the curves are sharp, but become more gentle the more the motion of the projectile is accelerated. $a\,b$ is the line which would be described by the writing-point if the fork did not oscillate, and the move between two successive points of intersection with the line $a\,b$, is that described by the fork in half an oscillation. Thus, if the number of oscillations of the fork in a second is known, the velocity of the projectile at any point can be at once read off. For example, let the number of oscillations in a second be 2000. We desire to know the velocity of the projectile after it has traversed half its own length. At this moment the writing-point would be exactly half-way down the bar at d. The distance ($e\,g$) is measured and found to be ·03 mètre. Between f (on a level with e) and g, the fork makes a quarter oscillation, and requires therefore $\frac{1}{8000}$ second. The distance between e and g, (·03 mètre) in which d lies, is therefore traversed in $\frac{1}{8000}$ second, and the velocity is therefore 240 mètres in a second.

FIG 2.



With this sliding-piece, the velocity can naturally only be determined for a distance somewhat smaller than the length of the projectile. Mr. Sebert has, however, indicated a method by which it may be registered for a longer distance. Shortly before reaching the base of the projectile, the sliding-piece frees another sliding-piece on the opposite side of the bar by pressing a catch. If, after this second sliding-piece is released, the velocity of the projectile is further increased, the second sliding-piece, which has the same velocity as the projectile at the moment of its being forced, falls back, and its writing-point registers in the same way as that of the first. To utilize the second velocity-curve, the velocity of the second sliding-piece at the moment of its being freed must be known, as also at what points of the bore the velocities indicated by the second curve were produced, and in what position of the projectile the second sliding-piece came into play. When the second of these three is known, the third is easily found. A great drawback to this extension of Sebert's method is that nothing can be assumed as certain with regard to the velocity of the second sliding-piece at the moment of its being freed, as its releasing takes time, and this time, and partly also the change of velocity during this time, are not known. If, therefore, a certain velocity be assumed, and the velocity-curves of the first and second forks form a continuous line, no conclusion can be formed as to the correctness of the assumed velocity, unless, as will seldom be the case, the continuity of the curve results from the assumption of this velocity. This drawback is met by the following extension of Sebert's method :—

FIG. 3.



In the interior of the projectile (*A B C D E*) is a half drum (*e e*), revolving on two trunnions fixed in slots (*a b*) in bars (*c b c*) and (*d a d*) screwed into the walls of the shell. This drum I shall call "writing-drum" (*Zeichen-trommel*). On the inside of the wall of the shell, between it and the drum, is fixed a fork whose longer axis is parallel to the circumference of the cross-section of the shell. In the figure only the ends (*i i*) of the prongs are shown. To these ends writing-points, which touch the drum, are fixed, and the drum is blackened.

The mode of determining the velocity of the projectile is as follows:—

When the projectile presses into the grooves, it begins to turn very rapidly, but the inertia of the writing-drum causes it to remain at rest. To ensure the latter remaining at rest when the projectile turns, it is given the form of a semi-circular plate, or, better still, of a semi-circular ring, so as to bring its centre of gravity as far as possible away from the axis of rotation of the projectile. It can be easily proved that if a body (*A*) can turn round the axis (*C*) of another body (*B*) and inside of *B*, and is such that its centre of gravity is not in the axis (*C*), the body (*A*) does not participate in the rotation of the body (*B*). The resistance to rotation is all the greater the farther the centre of gravity of *A* is from *e*.

Our projectile will therefore revolve round the writing-drum. If the fork did not oscillate, the lines drawn by it on the drum would be straight, but the inertia of the fork causes it to oscillate on the shock of discharge, as can be proved by striking a tuning-fork sideways on the pedicle, thus causing it to give forth sound. Other mechanical means of causing the fork to oscillate when the projectile begins to move, without forcing the drum to revolve also, could be easily applied, but, after what has been said, they are quite unnecessary.

The writing-points on the prongs of the fork describe "sine-curves" on the drum, from the shape of which the velocity of the projectile at any point in the bore can be at once read off. For if *e.g.* the projectile makes a quarter-revolution in the bore, that part of the curve at a distance from its initial point equal to one-eighth of the circumference of the drum will give the velocity of the projectile half way between the end of the grooves and the muzzle.[1] So as to prevent the curve described on the drum being obliterated, the drum is made to catch on a spring-hook after the gun has made half or a quarter revolution, so as to force it then to revolve with the latter.

The following method may be used to ascertain whether the drum, as proposed above, does not take part, to any appreciable extent, in the rotation of the projectile:—

The middle of the front part of the bar (*c b c*) is covered with an

---

[1] **Supposing the twist of the grooves to be uniform.**

insulating substance (*n n*). On this lies a small metal plate (*o o*), from which an insulated wire, which lies close on *c b c*, as shown in the figure, is led through *c b c*, and ends in a point opposite the writing-drum. On the apparatus being fixed, this point is at a curve-distance from the writing-point, equal to the curve described by the projectile within the grooves. In the head of the projectile is screwed a gutta-percha plug (*m*) through which an insulated wire (*y*) leads, whose outer end is bared, and whose inner end touches the plate (*o o*).

By this means a spark, which leaves its mark on the drum, can be produced in different ways at the moment the projectile leaves the bore. Either a plate of metal (*x*) can be placed at a distance from the muzzle equal to that between the head of the projectile and its base (driving) ring, this plate (*x*) being connected with the inner coating of a Leyden jar, while the outer coating is connected with the gun, and therefore with the projectile, or the plate (*x*) may be placed in the circuit of a secondary induction coil, while the current of the primary coil passes through a wire (*z*) which is broken by the projectile the moment *y* and *z* come into contact. In both cases (the latter is to be preferred as the spark leaves a better mark), a spark leaves its mark on the drum at the moment the projectile leaves the bore. If the drum has not participated in the rotation of the projectile, this mark will be at a distance from the beginning of the curve described by the fork equal to the same fraction of a revolution of the drum as the projectile has made in the bore, *i.e.*, in the above example, at a distance equal to one-fourth of the total circumference of the drum. If the drum has participated in the rotation of the projectile the mark of the spark will be closer to the beginning of the curve, and the more the drum has rotated the closer will it be.

It will easily be seen how with this method of registration there is also room inside the projectile for Sebert's apparatus to be used, if the writing-drum be placed at the base of the projectile, so that at the same time two curves may be registered which will check one another. The curves according to my system are of course not so extensive as those of Sebert, but the development of the latter is perhaps unnecesary.

The only objection which appears to me possible is that, with the enormous shock which the projectile has to bear, the writing-drum may be broken, or so bent, as to jam in the projectile. If, however, the drum is made of good steel, I do not believe that this will happen, and, at any rate, only trials can settle this point. I may also point out that the effects of this shock might be avoided by filling the projectile with a liquid.

ITALY.

I.

GIORNALE DI ARTIGLIERIA E GENIO,

DECEMBER, 1883.

BY

CAPTAIN E. B. EVANS, R.A.

A Fuze with Two-fold Action, and a Universal Projectile for Field Artillery.

By Captain U. Allason, Italian Artillery.

Continued from No. 3. Vol. XIII.

The question of the universal projectile for the Batteries of smaller calibre of our Field Artillery was studied in a similar manner to that described for the 9^{cm} B. L. guns, and experiments of the same nature led to almost identically the same results.

It was considered superfluous to compare the efficacy of shrapnel over common shell, both exploded by time-action, as it seemed evident that the 7^{cm} shrapnel, in this nature of practice, would exhibit the same superiority over the common shell of that calibre, as the 9^{cm} shrapnel had shown over the common shell of corresponding calibre.

The study of the nature of shrapnel most suitable for guns of small calibre, which had previously resulted in favour of the shrapnel with central charge, was taken up again in connection with the question of the universal projectile. It having been recognised that, in the case of the larger calibre, the diaphragm shrapnel was evidently superior to that with central charge, we desired to ascertain the reason why this superiority was not also shown in the case of the smaller calibre, and the cause of this appeared to be attributable to the manner in which the previous experiments had been carried out. The choice of the nature of shrapnel having become of much greater importance, now that it was a question of introducing a universal projectile, or at least one that should form the greater part of the equipment, it was thought

advisable to ascertain whether the experiments previously made had been carried out in the manner most suitable for showing the real properties of the diaphragm shrapnel.

On examining the tables showing the results of the trials made with the 7^{cm} shrapnel (published in an earlier number of the *Giornale*) it is impossible not to perceive that the diaphragm shrapnel was employed under such conditions as did not admit of its showing any superiority over the projectile with which it was compared, inasmuch as it was exploded at distances from the object exceedingly large, in comparison with those allowed with the shrapnel with central charge. The reason for this probably was, that at that time great importance was assigned to the lateral dispersion of the fragments, and, therefore, in endeavouring to cover with the diaphragm shrapnel an extent of front almost equal to that covered by the shrapnel with central charge, the superiority which the former could have been made to show in the matter of the number of hits, was not recognised.

But, it having been once demonstrated that the principal advantage of the diaphragm type is that it renders the efficacy of the fire less dependent upon accuracy of judging the range, and upon the regularity of the action of the fuze; and it being admitted that concentration of the effects of a single round are rather to be desired than otherwise, and that a sufficient amount of dispersion is always obtained, either by the natural variation of the positions of the points of explosion, or from the fact that there is always more than one piece firing at an object of any width; it was natural that the study of the question should be resumed with greater care, and that an endeavour should be made to establish a more accurate comparison between the two projectiles, by employing them under more comparable and more equal conditions.

It should also be noted that, at the time of which we are now speaking, it had already been shown by experiments made by some of the Regiments with the shrapnel with charge at the base, that this projectile did not present, in practice, the difficulty in judging the results which had been previously expected, and it was known that some of the Officers in the service were strongly in favour of the adoption of the diaphragm shrapnel.

Therefore, before proceeding to carry out experiments relating directly to the employment of the universal projectile, it being admitted that also for the 7^{cm} gun this projectile would be the shrapnel, trials were resumed for the determination of the best type of shrapnel for that calibre.

An alteration was first made in the diaphragm shrapnel, "Pattern No. 3 modified," which had been previously experimented with. The projectile was lengthened as much as the dimensions of the ammunition boxes would allow, not so much to increase its capacity as to increase its weight, and thus make it the same weight as the common shell of the same calibre. This was done with a view to rendering it possible to employ the same elevation for both projectiles, a simplification already attained for the 9^{cm} B. L. gun with the present ammunition.

Thus modified, the shrapnel when ready for use weighs 4·260 kils., that is almost the same as the common shell (4·280 kils.), and the

trials made with both, as a preliminary measure, show that the elevations required, even up to the longer ranges, are but little different as may be seen by Table A; from which it appears that the accuracy of firing with the diaphragm shrapnel is quite satisfactory, and that the centres of the two areas within which the shells fell could be made to coincide with very slight variation of the elevation.

TABLE A.

Shrapnel.	No. of Rounds.	Range in Metres.	Elevation in Metres.	Centre of the area within which the shells fell.		Space containing 50 per cent. of the hits.			Remarks.
				A.*	B.*	Height.	Width.	Depth.	
				metres.	metres.	metres.	metres.	metres.	
Service	8	800	24·5	6·28	6·13	0·44	0·39	...	On the target.
Diaphragm ...	10	...	24·5	5·88	6·41	0·61	0·49	...	〃
Service	10	1500	57·5	5·92	4·91	1·15	1·12	...	〃
Diaphragm ...	15	1500	57·5	7·48	3·09	0·88	2·33	...	〃
Service	12	2200	100	7·01	3·60	3·48	4·99	...	〃
Diaphragm ...	20	2200	102	5·11	3·06	2·81	2·06	...	〃
Service	15	3000	162	1·47	1·64	...	11·45	19·39	On the ground.
Diaphragm ...	25	3000	162	8·5	·54	...	16·25	31·16	〃

* I presume these columns show the distance of the centre of the area from the centre of the target.—*E. B. E.*

A first trial of the comparative efficacy of the diaphragm shrapnel, and that with central charge, was carried out by furnishing the two projectiles with a special percussion fuze, and causing them to burst on passing through a wooden screen. By this means, which had been adopted in similar experiments previously, both projectiles were made to burst at a fixed distance from the object fired at, that is in the manner which best allows of the variations in the effects being studied, according as the interval is small, medium, or large.

In order to determine exactly the effect produced by the interval, three series of rounds were fired with both projectiles at 1000 metres, placing the screen so as to produce the explosion at 40, 80 and 120 metres from the target, respectively. The targets consisted of four lines 2·50 metres high, 30 metres long, of screens 27 millimetres thick; placed, the first three, 20 metres one behind the other, and the fourth, 100 metres behind the third. The effects were noted after each round, so as to obtain with accuracy not only the number of hits, but also the average number of files struck per round.

The results of this preliminary trial are given in Table B, which shows that at a range of 1000 metres:—

1. With equal intervals the effect of the diaphragm shrapnel is

greater than that of the shrapnel with central charge, both as regards the number of files struck, and, more especially, as regards the number of hits.

2. The effect of the diaphragm shrapnel with large intervals, is almost as great as that of the other nature with small intervals.

TABLE B.

Shrapnel.	Number of Rounds.	Interval between point of explosion and target.	Average number of hits per round.					Average number of files struck per round.			
			On 1st line.	On 2nd line.	On 3rd line.	On 4th line.	On the 4 lines.	On 1st line.	On 2nd line.	On 3rd line.	On 4th line.
		metres.									
Service	8	40	44	27	13	2	86	13	13	9	2
Diaphragm ...	6	40	73	52	42	7	174	12	13	17	5
Service	9	80	23	13	10	4	50	14	11	9	4
Diaphragm ...	10	80	36	32	19	11	98	14	15	15	9
Service	10	120	9	6	5	2	22	6	6	5	2
Diaphragm ...	9	120	31	20	16	9	76	15	14	12	7

This result, which differed to some extent from that previously obtained in experiments carried out in a similar manner, but with a larger number of rounds, required to be confirmed by trials on a larger scale and at various ranges; and with this view two series of rounds were fired with each nature of projectile, at each of the three ranges, 800, 1600, and 2400 metres, producing the explosion by time-action, and endeavouring to obtain in one series (with each projectile) the interval considered most suitable to the shrapnel with central charge, and in the other series the large interval which may be held to be best suited to the diaphragm shrapnel. These trials were made with the double-action fuze, already described, arranged for time-action, and it exhibited a regularity of burning which allowed of the desired intervals being obtained with sufficient accuracy. The result is shown in Table C, where the rounds are grouped in such a manner as to enable a complete comparison to be drawn between the efficacy of the two projectiles, both as regards the number of files struck, and the number of hits. These trials seemed to show clearly that in the case of the 7^{cm} calibre, the shrapnel with charge at the base possesses the same superiority over that with central charge, as in the case of the 9^{cm} calibre, and that therefore the substitution of the diaphragm shrapnel for that in the service would offer the same advantages with the smaller calibre as those already mentioned with the larger.

Looking at the result of the trials already described, it would seem that also with the 7^{cm} gun, with equal intervals between the point of explosion and the object, the diaphragm shrapnel produces, in addition

TABLE C.

Ranges, &c.		Shrapnel.	Number of rounds on which the average is taken.	Average interval in metres.	Average number of hits through, per round, on first line struck.	Hits per round on the 4 lines. Through.	Hits per round on the 4 lines. Through and struck.	Average dispersion on first line struck, in metres.	Average number of files hit on first line struck.
RANGE 800 METRES. *1st Series.* Interval intended to be 60 metres	Taken round by round ...	Service	6	80	22	40	57	14·8	10
	〃 〃 ...	Diaphragm	8	73	49	88	120	9·7	7
	Average of all the rounds	Service	13	68	30	54	73	...	...
	〃 〃	Diaphragm	16	57	54	98	125	...	...
2nd Series. Interval intended to be 150 metres.........	Taken round by round ...	Service	6	147	17	26	57	14·8	8
	〃 〃 ...	Diaphragm	6	140	20	42	89	13·8	10
	Average of all the rounds	Service	15	149	13	21·5	45·5	...	...
	〃 〃	Diaphragm	15	142	20	41	73	...	...
3rd Series. Rounds more accurately comparable for interval and height of burst	Small interval	Service	3	74·1	27	46	64	15·2	10
	〃 〃	Diaphragm	4	24·8	50	89	128	11·4	8
	Large interval..............	Service	4	135	15	25	56	15	7·5
	〃 〃	Diaphragm	4	145	21	37	88	13·8	10
1600 METRES. *1st Series.* Interval intended to be 50 metres	Taken round by round ...	Service	7	62	26	47	78	12·7	9
	〃 〃 ...	Diaphragm	6	37	26	84	121	9·7	5
	Average of all the rounds	Service	16	52·5	30	50	76·5	...	...
	〃 〃	Diaphragm	14	47·5	23	75	109	...	...
2nd Series. Interval intended to be 100 metres.........	Taken round by round ...	Service	7	108	11·6	23	54	15·6	8
	〃 〃 ...	Diaphragm	6	83	34·5	58	93	11·8	7·5
	Average of all the rounds	Service	16	108·5	10·8	25	52	...	...
	〃 〃	Diaphragm	16	88	30	54	84·5	...	...
3rd Series. Rounds more accurately comparable for interval and height of burst	Small interval	Service	7	62	26	47	78	12·7	9
	〃 〃	Diaphragm	8	58	30	66	97	16·8	13
	Large interval..............	Service	4	100	12·7	27	58	15·9	8
	〃 〃	Diaphragm	2	105	25·5	50	84	13·2	8
2400 METRES. *1st Series.* Interval intended to be 30 metres	Taken round by round ...	Service	9	40	11	29	49	9·6	5·6
	〃 〃 ...	Diaphragm	8	28	30	41	69	10·6	5·7
	Average of all the rounds	Service	16	30·5	15·5	36	56	...	...
	〃 〃	Diaphragm	16	36	29·3	38	64	...	...
2nd Series. Interval intended to be 80 metres	Taken round by round ...	Service	6	84	7	16	35	12·8	5·8
	〃 〃 ...	Diaphragm	9	74	15	24	55	12·7	9·5
	Average of all the rounds	Service	15	70	7·5	17	32	...	...
	〃 〃	Diaphragm	18	82	12·5	20	47	...	...
3rd Series. Rounds more accurately comparable for interval and height of burst.	Small interval	Service	6	46	12·3	27	46	8·8	5·3
	〃 〃	Diaphragm	4	45	25·7	39	65	10	6
	Large interval	Service	4	78	8	18	34	12·9	5·7
	〃 〃	Diaphragm	4	78	19	23	54	13·8	8

to a decidedly larger number of hits, a lateral dispersion, or number of files covered, but little different to that of the shrapnel with central charge. And when this latter difference is found to be more or less

accidental, and not to be repeated invariably in successive trials, too much importance, as we have already observed, must not be attached to it.

The experiments with reference to the adoption of a single projectile for the 7^{cm} Batteries were from this time carried out with the diaphragm shrapnel shell; and with these guns also the first point to which attention was directed, was that relative to the possibility of employing shrapnel burst by percussion on striking the ground, as a substitute for common shell for determining the range.

The trials made with the 7^{cm} guns gave the same results as those with the 9^{cm}, showing that there was no appreciable difference in the difficulty of judging the position of the point of explosion of the two natures of projectiles; and that the accuracy of the judging was affected far less by the projectile than by the form and size of the target, the nature of the ground, and the atmospheric conditions at the moment.

We give as an example, in Table D, the result of one of the series of experiments made with this object.

TABLE D.

Range.	No. of Rounds.	Common Shell.		Shrapnel.		Target.
		Judged from the Battery.	As measured.	Judged from the Battery.	As measured.	
metres 1500	1	Burst long	Burst long 15 m.	Burst short	Burst short 20 m.	The target represented a platoon of Infantry kneeling.
"	2	" "	" " 8 "	" "	" " 6 "	
"	3	" "	" " 10 "	" long	" long 25 "	
"	4	" "	" " 15 "	" "	" " 6 "	
"	5	" short	" short 5 "	" short	" short 15 "	
"	6	" "	" " 10 "	" "	" " 25 "	
3000	1	" long	" long 60 "	" "	" " 100 "	
"	2	" "	" " 100 "	Doubtful	Blind	
"	3	" short	" " 80 "	Burst prematurely	...	
"	4	" long	" " 70 "	Burst long	Burst short 60 m.	
"	5	" "	" " 40 "	Doubtful	" " 50 "	
"	6	" "	" " 20 "	"	" " 30 "	
"	7	" "	" " 30 "	Burst short	" " 200 "	
"	8	" "	" " 15 "	" "	" " 30 "	

We have already stated for what reason it was not considered necessary to carry out experiments to show the comparative effect of shrapnel

and common shell against troops, when both the projectiles were exploded by means of time fuzes. We may add that it seemed of more use, instead, to compare their action when exploded by percussion. Experiments in this direction showed also with the 7^{cm} calibre the absolute superiority of the shrapnel. In fact, at ranges of 1500 metres, firing at the usual three lines of targets, the shrapnel burst at an average distance of 15 metres from the first line, gave 52 hits per round on the first line, and 91 on the three lines: while the common shell, under the same conditions, but burst at an average distance of 5 metres only, gave but 23 hits per round on the first line and 43 on the three. The experiments, however, showed that with the 7^{cm} gun, on account of the rapid increase of the angle of impact and decrease of accuracy, with the increase of the range, the effects of the shrapnel exploded by percussion, while maintaining their superiority over those of the common shell, diminish so greatly at long ranges, that in a series of 13 rounds fired at 3000 metres, it was found possible to make only a very few strike sufficiently near the target to produce any appreciable effect upon it. It must therefore be considered that with this calibre also it will always be necessary, at the longer ranges, to explode the projectile by means of a time fuze, in order to obtain any useful result.

From the experiments carried out, we may conclude that in firing with percussion fuzes, the efficiency of the shrapnel, compared with that of the common shell, is in the same proportion with the 7^{cm} as with the 9^{cm} guns, namely, about 2 to 1.

The comparative effects of shrapnel and case shot were not experimented upon with the 7^{cm} guns, either because it might be presumed that the experiments would lead to the same conclusions as those arrived at in the case of the higher calibre, or because the question of eliminating the case shot from the equipment, ought to be determined from other conditions than the small difference in the effects produced, that is to say, a few hits more or less.

The simplicity of the case shot is sufficient to recommend its being retained in the small proportion at present in the equipment, and if the decision in the matter must depend upon experiment, the experiment could only be one with a view to establishing practically, whether by means of proper instruction of the detachments, it would be possible to keep off sudden attacks of Cavalry by shrapnel shell exploded with time fuzes at very short ranges.

It being admitted that with the double-action fuze, previously described, it is possible to employ shrapnel as a partial substitute for case, it may be allowed that the present proportion of case in the equipment is sufficient in all cases; and even abundant, when, if we remember that in the campaign of 1870–71, the German Artillery, out of 250,000 rounds fired, only used 280 charges of case.

Finally, the trials made to ascertain the effect of the shrapnel in the demolition of masonry, &c., showed that its destructive power is only about half that of common shell, so that it would be necessary greatly to increase the number of rounds, in order to produce with the former the effect of the latter. Considering, however, that the Batteries of

small calibre are intended almost exclusively for action against troops, and that the effect of the 7^{cm} common shell against masonry is but small, it appears to us questionable whether it is advantageous, in spite of the inferiority of the shrapnel in this particular, to retain any common shell in the equipment of these Batteries.

Having thus described the experiments which formed the basis for a preliminary judgment on the subject of the uniform projectile for our Field Artillery, and having pointed out that the final decision in each case is to be governed by the result of a trial on a large scale, carried out by the Regiments, we may be permitted to allude to certain points bearing upon this important question.

The diaphragm shrapnel made use of in these experiments were of cast-iron, and it should be noted that shrapnel for field service, of the same type, with bodies of steel, have for some time past been under trial in other countries, and are still being tried. Herr T. Krupp at the end of 1878, employing wrought-iron, succeeded in producing shrapnel of 9^{cm} and 7^{cm}, with walls considerably thinner than those of ours. By thus increasing the capacity of the projectile, the 9^{cm} shell was made to hold 182 bullets, and the 7^{cm} shell 100, or very nearly the number contained by our shrapnel with central charge, and therefore a considerably larger number of bullets than are contained by our diaphragm shrapnel. It was shown, however, in a previous number of this Journal (*Giornale di Artiglieria e Genio, 1880, p. 244*) that these shells did not exhibit a superiority over ours of the same type corresponding to the greater number of bullets which they contained.

The German Artillery are experimenting at the present time with a diaphragm shrapnel, having the body of steel and the head of cast-iron, and it is probable that a projectile of this nature would be found to unite the greatest effect with reasonable simplicity in manufacture and facility in employment.

We also have for some time past been making experiments with a view to the introduction of shrapnel of a similar type, with a steel body. It does not seem however to be necessary to await the result of these experiments, before carrying out trials on a large scale by the Regiments, since it may be presumed that the new projectile will only be a more perfect form of shrapnel, and cannot alter the conditions of the problem relating to the adoption of a universal projectile, or only to a very small extent. It is probable that we may apply to the new shrapnel the conclusions arrived at with reference to those already experimented with; and if these conclusions are confirmed by the trials on a large scale about to be carried out, and if at the same time the study of the steel shrapnel should lead to a favorable result, the introduction of the latter into our service will only be a more perfect solution of the problem which is being studied by the Artilleries of various nations.

It cannot be denied that the general tendency at present is in the direction of increasing the proportion of shrapnel in the equipment of Field Artillery. The objections to the employment of this nature of projectile have not, it is true, entirely lost their force, but it is certain that since the introduction of the rifled guns, which permit of the employment of elongated projectiles in place of spherical ones, all armies

have gradually introduced the shrapnel into their equipment; and if in some cases it has disappeared again for a time, the study of the projectile has not been abandoned, but after its disappearance it has shortly been introduced in larger proportion and in an improved form. Since the Prussian Artillery in the campaign of 1870, throughout almost of the whole of which they employed only common shell, recognised the disadvantage of not possessing shrapnel in their equipment, all Artillery have studied with greater care and increasing activity this projectile, which is by no means a new one, since its invention dates from 1806, but which could not be considered complete until the invention of accurate time-fuzes.

The percussion fuze, which may be said to have come into general use at the same time as the cylindro-ogival projectile, soon attained a state of perfection which the time fuze has only reached quite recently; and the employment of common shell with a percussion fuze is undoubtedly far simpler than that of shrapnel with a time-fuze; and in this we think lies the principal reason why some have been too slow to adopt the shrapnel, and why there is still some opposition to its more extended employment.

But if it is true that the use of common shell is simpler, and requires less instruction on the part of the men, it is no less true that its destructive effects are practically but small at all ranges, even under the most favourable conditions, seeing that the common shell must strike the ground very close to the target in order to produce any effect on the latter, and that very slight irregularity of the ground may almost entirely destroy the effect of the explosion. The effects produced also diminish very rapidly with the increase of the range, and there are hardly any effects at ranges at which the projectile does not ricochet.

The effect produced by shrapnel is more independent of the nature of the ground, and does not decrease so rapidly with the increase of the angle of descent, but in order that the full effect of this projectile may be obtained, more extended and accurate instruction of the men is necessary, and it is indispensable that the fuze with which it is furnished should act with great regularity, and in the manner corresponding with the graduation determined by experiment, because the judging of the position of the point of explosion is never easy, and becomes exceedingly difficult at long ranges.

Under these conditions the effect of the shrapnel is so superior to that of common shell, as to make it decidedly preferable for Field Artillery: and if, in addition, the fuze employed with it can be made to act also by percussion, undoubtedly this projectile can be employed for almost all the requirements of field warfare, and the proportion of common shell can be reduced to that necessary to meet the few cases likely to occur of having to destroy some serious obstacle, a task which should be left to the heavier Batteries.

The Artillery which appears to have advanced the farthest in this direction, is that of Sweden and Norway, which in the arrangement of a new equipment for Field Batteries, undertaken a short time since, decided that its armament should consist exclusively of shrapnel with a double-action fuze. We do not know, however, whether this system

should actually be fully adopted, or whether, as we retain a few case shot in the equipment, we should also retain a few common shell.

The proportion of shrapnel was always large in the English Artillery, where this projectile had its birth; at present it forms more than $\frac{3}{4}$ of the ammunition of the M. L. Batteries, and the proportion seems to be increasing in that of the Batteries armed with B. L. guns.

The Prussian Artillery, which in the campaign of 1866 had $\frac{1}{5}$ of shrapnel, and which went through almost all that of 1870 without that projectile, has at present about 40 per cent. of shrapnel in the Field Batteries, and is studying more perfect types, probably with a view to increasing the proportion.

In France the proportion of shrapnel is about $\frac{1}{3}$ for the light Batteries, and rather more (about $\frac{2}{5}$) for those of the 9^{cm} guns. In Russia the proportion is exactly $\frac{1}{2}$. The Austrians have only about $\frac{1}{4}$ shrapnel in the equipment of their Field Batteries. With ourselves (the Italians) the proportion of shrapnel as first established, was between $\frac{1}{3}$ and $\frac{1}{4}$; this has been gradually raised to $\frac{1}{2}$, which is the proportion at present. The conditions, already explained, which would render practicable a further and more considerable increase of the proportion of shrapnel, if not the adoption of a universal projectile, do not seem to us to be impossible of realization. As far as the fuze is concerned, the difficulty may be considered to be overcome, if the double-action fuze, described in the first portion of this article, exhibits in experiments on a large scale the same regularity as in those which led to its adoption;[1] as to the instruction of the men, that is a question which cannot be dealt with in this paper, but it seems to us that when we have once recognized the road which can lead to the object we have in view, we should not hesitate to set out upon it and to follow it up.

---

[1] During the compilation of this paper, a slight alteration has been introduced into this fuze, with a view to retaining the hammer, of the percussion apparatus for igniting the time-fuze composition, more securely in its place during transport. This alteration consists in placing the safety-plate, with its tooth for cutting the covering of the composition, directly under the hammer instead of to one side of it, and adding a projection to the upper part of the plate so as to support the hammer; it thus becomes impossible for the hammer to fall until the plate is withdrawn. With this alteration, not only is the hammer supported more securely during transport, bnt also there is no possibility of the time-action taking effect when only percussion-action is required.

NOTES:

BY VARIOUS HANDS.

The following high compliment has been paid to Professor Greenhill for his paper on the "Motion of a Projectile in a Resisting Medium," "Proceedings," Vol. XI., p. 131, by Major Siacci, Royal (Italian) Artillery, in the "*Rivista di Artiglieria e Genio,*" October, 1884, p. 92:—

"Mention must be made of a most admirable paper on the 'Motion of a Projectile,' by Professor Greenhill, Professor of Mathematics to the Advanced Class, Woolwich. By means of Elliptic Functions, the Professor gives not only an explicit, but an *exact* equation of the trajectory in the case of the resistance varying as the cube of the velocity. . . . . I do not hesitate to say that, from a scientific point of view, Professor Greenhill's results are the most important obtained since the time of Newton, Bernonilli, and Euler."—*H.W.L.H.*

The following are published in continuation of the Notes on the same subject, which appeared in "Proceedings," Vol. XII., No. 9, for March, 1884, and Vol. XIII., No. 6, for December, 1884:—

Notes on a Collection of Artillery Drawings in the R.A. Library, Woolwich.

By the late Lieut.-Colonel F. Miller, V.C., Royal Artillery.

The drawings in this volume, No. 1678, were, until 1867, tied up in a rude sort of portfolio, made with two loose pieces of millboard, and marked outside "Venetian Artillery;" a name little applicable to the general contents. There was no memorandum to show how they were obtained, nor is there any record of the draughtsman's name.

The authorship of these plates may, however, be attributed with strong probability to Albert Borgardt, first Colonel of the Royal Regiment of Artillery, of whose professional industry and skilful drawing there are many examples extant. A manuscript collection in the R.A. Library, No. 11956, contains several drawings, of various dates from 1693 to 1722, some of which are fronts of fortification, beautifully coloured and elaborately finished, signed "Albert Borgardt." 1715. The inscription under one of the mortars, plate 24, "Buda, 1686," is in handwriting of the same character as the above signatures, and may

well have reference to the siege in that year recorded among Borgard's personal services. It adds considerably to the interest of these drawings to have cause to believe that they were done by such a distinguished hand.

The subjects include several mortars, a few cannon, a petard, a pontoon and its carriage, a forge cart, and a triangle gyn, drawn to various scales. Some of the mortars are accompanied by a shell and a carcass, and there is a very peculiar hollow projectile, with cylindrical sides and a pointed base, at p. 27. Most of the pieces are mounted, and there are some mortar-beds drawn separately. Most of the series are well executed and carefully finished, but some are not carried beyond a pencil outline.

All the Ordnance are of brass. Many of the mortars are cast in one piece, with a plate which was bolted down to the bed. Such pieces had no trunnions. The guns at pages 31, 33, and 34 are very curious from the form of their cascables and the manner in which they are mounted; No. 33 has a coat-of-arms on the reinforce which seems intended for that of the Board of Ordnance. No. 17 is also curious, and Nos. 27 and 28 are of a very peculiar construction. At p. 29 there is a missile whose application is not at all obvious.

One of the mortars (p. 26) is called "Sr. Hen^{n} Sheers": this gentleman was doubtless the Henry Sheares, Esq., who appears as "Comptroller" in a Train of Artillery organized for service against the Duke of Monmouth in 1695.

The bores are in all cases terminated by chambers, whose forms are very various. The majority of them are constructed on a principle which has long been disused, although it was very commonly applied in the 18th century, and Professor Muller, who wrote on Artillery in 1757 and 1780, considered it the best for obtaining the greatest effect from the powder upon the projectile. This principle, as stated by Muller, is that "It is not the inward figure of the chamber but its "entrance which produces the effect; because the smaller it is the "nearer it reduces the effect into the direction of the shell." (1780: Introduction, p. xx.) On this theory, the chambers were made spherical, or pear-shaped, with a mouth of less diameter than the interior.

Two English mortars (at pp. 1 and 25) have an enlargement at the fore part of the chamber for the reception of a wooden bottom or tampion, which was formerly inserted between the powder and the shell. Others, probably foreign, have what Muller calls a "cup" at the vent end; the object of this was that the powder might be ignited at the extreme end of the charge. He states that experiments of his own proved the advantage of this arrangement for mortars.

The mortar-beds are generally of wood, strengthened with iron, but one of them (p. 10) is of brass, and very nearly of the same form as the iron land service beds in present use.

The shells and carcasses are cast much thicker at the bottom than at the fuze-hole. They have generally lugs for lifting them, but at p. 21 they are fitted with holes like the "Lewis holes," adopted for our own 13-inch shells about 1860.

The sheets on which the drawings are made are numbered from 1 to 33, but Nos. 16, 17, and 29 are missing. As some of the sheets contain only one, and others have two drawings, I have given a separate number to each leaf for convenience of reference.

F. M.
8th June, 1867.

List of the Drawings.

(The references are to the numbers in red ink on the leaves.)

1. 13-inch mortar, with trunnions, on a wooden Sea Service bed; apparently an English piece.
3. 13-inch mortar, with base plate; an iron plug screwed in at the bottom of the chamber.
4. 12½-inch mortar, with base plate; marked "Genoa."
5. 13-inch mortar; fixed; also a "bomb" and a "carcasse."
6. 13-inch mortar, nearly similar to the last.
7. Plan of a Sea Service mortar-bed.
9. A short chambered piece, apparently ancient; 7-inch calibre.
10. 13-inch brass mortar, with trunnions, mounted on a brass bed similar to the present iron beds.
11. 11½-inch mortar, fixed and mounted; marked "Genoa."
12. 18-inch mortar, with a section of its bomb; marked "Tunis."
13. 12-inch mortar; marked "Tunnis."
14. 12-inch mortar; marked "Argiers."
15. 12½-inch mortar; marked "The last French Model."
16. 12½-inch mortar; marked "Genoa."
17. A short chambered brass piece, with three greyhounds (?) upon it.
19. A mortar with trunnions; no scale.
21. 18½-inch pierrier or mortar; the shell fitted with Lewis holes.
23. The same, in pencil.
24. 15-inch mortar, with trunnions; marked "Buda 1686."
25. 12½-inch mortar, with trunnions.
26. The same, mounted for Sea Service, and called "Sr Henn Sheers Mortar."
27. Piece of special construction, and with a peculiar kind of shell.
28. Another abnormal piece.
29. A chamber-bored cannon, accompanied by a peculiar missile or machine.
30. 10½-inch mortar.
31. Curious piece attached to an iron carriage by means of a flat cascable.
32. A long chamber-bored piece on a "rear-chock" carriage.
33. A piece nearly similar to No. 31, but on a field carriage.
34. Another piece like No. 31; 9 inches calibre.
35. Section of a bomb-ketch; transverse.
37. Another section, probably longitudinal.
39. Drawings of a pontoon, showing the sides, ends, and bottom.
40. Perspective general view of a pontoon, with balks, &c.
41. Wooden bed for a mortar; three views.
43. Forge cart, with anvil, &c.
44. Triangle gyn; probably of a foreign pattern.
45. 10-inch mortar-bed; similar to No. 41.
47. 15-inch mortar-bed.
49. Petard, with its appurtenances.
52. 18-inch mortar-bed.
54. 13-inch mortar-bed.
56. "Sr Martin Beckman's Carriage to his 18-inch Mortar."

58., 60. } Brass field gun, with the brackets, wheel, nave, and axletree of its carriage.

Table of the Guns and Mortars in the Collection.

No.	Guns and Mortars.	Length.		Weight.	Remarks.
		Bore.	Piece.		
	Guns.	cals.	ft. ins.	lbs.	
9	7-inch; short, chambered ...	$5\frac{1}{2}$	3 9	...	...
32	5-inch; chambered	$13\frac{1}{2}$	6 3	...	...
27	4-inch; do.	$6\frac{1}{5}$	4 0	...	With a curious shell.
28	6-inch; do.	$11\frac{3}{4}$	7 0	...	...
34	9-inch, with flat cascable ...	3	2 9	...	...
31	5-inch. do. ...	5	2 7	...	...
33	3-inch, do. ...	$10\frac{1}{3}$	2 6	...	With the Ordnance (?) Arms.
29	Chambered piece...	$8\frac{1}{3}$	...	...	...
17	Do.	4	..	...	3 greyhounds on the exterior.
	Mortars.				
21	$18\frac{1}{2}$-inch (perrier)	$2\frac{1}{4}$	4 0	...	Trunnions in the middle.
12	18-inch, "Tunis"	$2\frac{1}{6}$	4 3	8,699	...
24	15-inch, "Buda, 1686" ...	$2\frac{1}{3}$	3 9	...	...
5	13-inch	$3\frac{1}{2}$	4 8	...	...
1	Do.	$3\frac{1}{3}$	5 6	...	...
6	Do.	$3\frac{1}{3}$	4 5	...	...
10	Do., "Argiers"	2	3 2	...	...
3	Do.	$3\frac{1}{2}$	4 10	...	...
4	$12\frac{1}{2}$-inch, "Genoa"	$2\frac{2}{3}$	3 6	6,900	...
16	Do., "Genoa"	$2\frac{2}{3}$	3 6	6,900	...
15	Do., "French"	$2\frac{1}{2}$	3 2	7,000	...
26	Do., "Sir H. Sheers"...	3	4 7	...	$52\frac{5}{8}$ cwt.
13	12-inch, "Tunis"	4	3 0	6,940	...
14	Do., "Argiers"	$3\frac{2}{3}$	2 9	...	...
11	$11\frac{1}{2}$-inch, "Genoa"	3	3 0	...	...
30	$10\frac{1}{2}$-inch	3	3 0	...	...

SEPARATE numbers of Major Tyler's paper on the "Care of Battery Horses" can be had on receipt of the postage, 1d.—*H.W.L.H.*

HORSE SICKNESS, OR ANTHRAX, IN SOUTH AFRICA.

ITS NATURE, CAUSES, PREVENTION, SYMPTOMS, AND TREATMENT:

BY

JAMES LAMBERT, Esq., F.R.C.V.S.,

INSPECTING VETERINARY SURGEON, ARMY VETERINARY DEPARTMENT,

LATE PRINCIPAL VETERINARY SURGEON TO THE FORCES, NATAL.

Re-Printed from the Natal Government Gazette.[1]

COMMUNICATED BY

THE SECRETARY.

In this paper the use of technical and scientific terms is, as far as possible, avoided, and what to many persons may appear to be very simple matters, are explained at some length, and sometimes with reiteration, so that there may be no trouble in fully understanding what we wish to convey to the minds of our readers.

Horse sickness is Anthrax, therefore Horse sickness and Anthrax in this essay have the same meaning, and are the same malady; but before going particularly into the subject of Horse sickness, we will make some general remarks on the disease.

Anthrax is a term used to express a disease which in different countries attacks all animals, and which is caused by the existence in the blood and fluids of the body of a microscopic parasitic organism of a vegetable nature, and introduced from without. The results produced by this parasite—scientifically termed the *Bacillus Anthracis*—will be described as we proceed.

Anthrax is the most universal disease we know. It attacks animals of all kinds (man included), some species in one region, some in another, and even birds and fishes, and no part of the globe is free from it.

In his very valuable and learned work, "*Veterinary Sanitary Science and Police*," Vol. II., Mr. Fleming, Army Inspecting Veterinary Surgeon, says:—"It has been carefully described by travellers and others as they have observed it affecting animals in Siberia, Lapland, Finland, Egypt, the East and West Indies, Russia, Central Asia, China,

---

[1] This Paper was originally headed by the following notice:—

Government Notice No. 448; 1881.

His Excellency the Governor directs the publication, for general information, of the following Paper upon Horse Sickness or Anthrax in South Africa; by James Lambert, Esq., F.R.C.V.S., Principal Veterinary Surgeon to the Forces, Natal.

By His Excellency's command,
C. B. H. MITCHELL,
Colonial Secretary,

Colonial Secretary's Office, Natal,
October 29, 1881.

Cochin China, various parts of North and South America, and different regions of Africa, while for European countries the writings which have been published with regard to its nature and peculiar characteristics, and the damage it inflicts are innumerable."

In Scotland, Anthrax mostly attacks sheep, and is there called Braxy; in England it chiefly assails cattle, and is commonly called Splenic Fever or Quarter Ill, Blackleg, Blain, &c. In France it is called Charbon, and is an awful scourge to sheep. The celebrated Professor Pasteur, at the International Medical Congress this year in England, stated that sheep to the value of twenty million francs annually die of it in France, where certain districts are notorious for it. In one, Beauce, it is calculated that the yearly loss from this disease is one hundred and seventy-eight thousand sheep. Great mortality has this year been caused in many parts of the Russian Empire amongst horses and cattle, and also mankind, by the so-called Siberian Plague, which is Anthrax. This disease must not be confounded with Rinderpest.

That many deaths have occurred to human beings in Russia and other countries from Anthrax is not a matter for surprise, because we frequently have fatal cases in England from the so-called "woolsorter's disease." This malady, which is now attracting much attention, occurs in the West Riding of Yorkshire, and is undoubtedly caused by the workmen handling Anthrax-infected wool and hair. More than one hundred thousand bales of Eastern wool are annually imported into England. It has been suggested that the importation of fleeces and goat's hair which have been cut from dead animals—easily recognised by experts—should be prohibited, but there would be so many means of evading this that the law would be almost useless. It would be so easy to mix such wool with that cut from healthy living animals, that endless expense and trouble would be caused by the inspection. Very severe punishments, if they could be arranged between the several countries concerned, would alone prevent such dangerous rascality.

So far as we know, Anthrax does not appear in man and the carnivora (animals subsisting on flesh) unless caught from other animals. But in herbivora (animals subsisting on grass, herbs, vegetables), and in pigs it arises readily enough, and also in many kinds of birds, including fowls, geese, ducks, turkeys, pigeons, &c.

Anthrax in some countries is *very contagious*, that is "catching," while in others it seems to be rarely or never so. Horse sickness in South Africa does not appear to be contagious. But a disease like Anthrax may at any time become contagious, therefore they who are wise will, even in cases of Horse sickness, take precautions both before and after the affected animal's death. Climate probably causes the differences in the contagious and non-contagious character of Anthrax.

Horse sickness in India is called Loodiana Fever, and is there very destructive to horses, and the greatest precautions have to be taken to prevent contagion. It chiefly shows itself by swellings about the head and neck, but its essential characteristics are the same as those of Horse sickness here in Natal.

In all species of animals there are certain common (after death) appearances in the various kinds of Anthrax, viz., Horse sickness, Charbon, Blain, Gloss-Anthrax, Splenic Apoplexy, Siberian Plague, &c., which readily enable us to see that the maladies are only different manifestations of the same disease. We observe what plainly shows us that it is an affection of no one particular part of the body, but that it is constitutional, or, in other words, that it pervades all parts of the system.

Let us now, in order to see what kind of a disease Anthrax is, make an examination of the body of a horse which has died here in Pietermaritzburg from Horse sickness. Very often the first thing that strikes us on approaching the spot is a great swelling of the body, and a discharge of froth from the nostrils. This froth is frequently as white as snow, and sometimes will project from the nose like a large mass of the purest cotton wool. The cause of this peculiar appearance will be explained as we proceed. Removing the skin we see collections of yellow transparent jelly-like material in and between the muscles, and where there is most room for it, about the neck, especially the lower side of it from the head to the chest. There is a quantity of this gelatinous substance about the windpipe (trachea), and there is much of it on the lungs and under what is called the pleura, that is, the bright shining membrane covering the lungs. There is also plenty of it in many parts of the chest, the abdomen, &c. If we cut into the lungs we find a quantity of this jelly in the air-carrying tubes, especially the windpipe, and the small ones called the bronchial tubes, into which the windpipe divides, so as to allow air to pass to all parts of the lungs. Now, if we expose this citron-coloured gelatinous substance to the atmosphere it soon liquefies, and appears to turn to water, but when subjected to the action of the lungs, owing to their elasticity both before and after death, it mixes with the air, and works up into froth, which, when it appears before death, speedily suffocates the animal—a most painful sight, often witnessed last April and May in Maritzburg. Sometimes there is no frothy discharge from the nose either before or after death, and in such cases it is absent because little of the jelly-like material is formed, or rather poured into the air tubes of the lungs.

It is the presence of this jelly-like substance that has given rise to the popular fallacy that Horse sickness is a disease of the lungs; but it is no more a malady confined to the lungs than is Lung sickness,—the contagious Pleuro-Pneumonia of cattle. The fact is that these diseases attack and pervade every part of the system, but show themselves to the ordinary observer more in the lungs, because these are very large and open-textured organs, and therefore the products of the malady find space and suitable location. That the contagious lung sickness of cattle is not a disease confined to the lungs is proved by preventive inoculation, which, being employed on the tip of the tail, causes the usual fever without sensibly affecting the lungs, which vital organs it is the main object of the operation to protect. We have not then inflammation of the lungs in Horse sickness, and we may here state that we have not Enteric Fever.

To continue our post-mortem examination. Sometimes we find black spots and stains on the heart, and various muscles, and other parts. The blood in the blood-vessels coagulates very imperfectly or not at all, and is dark coloured and tar-like, and it stains muscles, &c., if left long in contact with them, and often when we cut into the muscles we find these dark stains inside them. Sometimes we find the tongue swollen and dark coloured. Sometimes we find the stomach and intestines with red and dark patches inside them as if corroded, which appearances have led some observers to erroneously consider the disease to be Enteric Fever. If we turn down the eyelids and look at what in health is the pink membrane lining them, we see small claret-coloured spots here and there on it. All the above appearances admit of easy scientific explanation which, however, is here unnecessary; suffice it now to say, that they are clear indications of a disease affecting the blood, and, by it, all parts of the body. Horse sickness then is a malady which everywhere poisons the system, and which, as will be further explained, depends upon a living parasitic poison introduced from without.

The first described after death appearances are those we see in horses and mules in Natal, but they are also, with some variations, those usually observed in Anthrax-destroyed animals all over the world.

Nature and Causes of Horse Sickness.

We will now specially consider that variety of Anthrax which, in South Africa, is called Horse sickness. It is a soil-developed disease, produced by a living microscopical organism, of a vegetable nature, scientifically called *Bacillus Anthracis*, of which the germs are exceedingly minute, so much so as to be readily carried in the air. These germs are taken in by the animal in its food, or by breathing a malarious or miasmatic atmosphere which contains them. Malaria literally means bad air, but we here use the term to indicate air given off from foul or marshy or swampy ground, and containing the poisonous germs which, when they get into the body of a susceptible animal, have the power of multiplying themselves and causing changes in the blood injurious and destructive to life. The word miasma is quite as good as malaria, and we here wish it to be understood as conveying the same meaning.

In Natal the seasons are, Spring—August, September, October; Summer—November, December, January; Autumn—February, March, April; Winter—May, June, July, August. The wet season, September, October, November, December, January, February, March. The Horse sickness season is therefore just when we should expect in March, April, and May, although cases now and then occur in any month. We saw an undoubted case in a horse in Pietermaritzburg in June, and in a mule at Karkloof in August.

Anthrax in all countries occurs most frequently in marshy, swampy, and low-lying districts, and in places where the surface water does not readily escape, or evaporates very slowly. In Great Britain, not only the domesticated animals but also mankind at one time suffered terribly from Anthrax, but good drainage and improved agriculture have in a very great measure banished it. There is little doubt, we think, that

such will be the case in South Africa. Countries most backward in agriculture suffer most from Anthrax.

Nothing is more common than to hear Natal colonists say, that horses which are kept up and fed in stables, are much less liable to Horse sickness than those which are turned out to graze on dewy grass: and nothing is more true. Many people aver that a stabled horse will not take the disease, but they are mistaken, as we saw in Pietermaritzburg this year (1881). But it is a *practical* fact that stabled horses are very much less liable to it; and, from the foregoing remarks about the nature of the disease, we can easily see why it should be so.

We must now mention another colonial belief, which is, that eating dewy grass is bad and productive of Horse sickness in many districts. Such experience is not confined to Anthrax in South Africa, but it is well known and acted upon in other countries.

Is the dew theory tenable, in practice? It is; and as much importance is attached to it in Natal, we will examine it at some length. We have said that Horse sickness is a soil-developed disease, or in other words, that it depends upon the emanation of germs from the soil. Now, it is the current belief among the most advanced pathologists, and we think with very good reason, that all miasmatic and contagious and infectious diseases, depend upon *living* poisonous matter, which exists as very minute germs, and which living poisonous matter is introduced from without. We all know that if we wet a piece of cloth and hang it out in the air, it will more or less speedily dry. It does so by what is termed evaporation, that is, the moisture passes as vapour into the air, although very often, in fact usually, we cannot see it doing so. Thus it is with the exceedingly minute germs which rise from the soil and produce Horse sickness. They are soil-developed, and when the watery vapour rises by evaporation, they are entangled in it, and float in it, for they are small enough and light enough to readily do so, and thus they are carried a certain height into the atmosphere. We all know that when the dew "falls" it is only the watery vapour of the air which condenses on different cold objects on the earth, in this instance the grass; consequently great quantities of the germs fall with and become condensed in the dew, and if a horse eats much dewy grass he is likely to get a large quantity of the poison in a concentrated form. But why does not the animal get enough poisonous germ from the air alone to cause Horse sickness? So he frequently does in bad situations, as we shall presently understand.

It must not, however, be argued from this dew theory, that if we can protect animals from eating the dewy grass we can thereby be sure of preventing Horse sickness, for it is very probable, nay certain, that air containing germs in sufficient quantity will, if breathed, give access to them through the lungs, and so they may enter the blood, as is the case with the germs producing many other diseases. The lungs very readily absorb many things brought into them by the atmosphere.

We may here mention that during the Zulu war, we had, in the 17th Lancers, on our arrival in this country, nosebags of flannel issued to filter the air at night, and to prevent the horses from eating the dewy grass, but we did not find those which wore them less liable to sickness than those without them. This is not to be wondered at, for

such contrivances are constantly getting out of order, and, besides, are obviously, when we consider how the disease is produced, imperfect and inadequate for the purpose intended. It is not, however, here denied that in some bad situations they might be useful. We may add that in the Zulu campaign the 17th Lancers lost very few horses from Horse sickness, as it was not the season for it, and we were fortunate in the ground where the troops usually encamped.

"The morning dews have been blamed by shepherds for causing abortion and Anthrax Fevers, and those who attend the Merino sheep in Spain do not turn out their flocks from January until June before the sun has dispelled the dew, for fear of the Basquilla, Anthrax Fever."—*Veterinary Science and Police; Vol. I.*

If you will, in the Horse sickness season—and at other times too—get up very early and ride on the high hills around Pietermaritzburg, you will frequently see many of the valleys, and perhaps part of the city itself, bathed in mist, which is, of course, charged with emanations from the soil over which it floats, and such being the case, we cannot be surprised that some stabled horses were last Horse sickness season destroyed by the disease. The mortality among horses and mules in the valleys near Pietermaritzburg was great, though only what we should anticipate in an unusually bad Horse sickness season, when we consider the nature of the malady.

The mists and fogs which hang over marshes and foul or swampy ground, during the *night and early morning*, are the most dangerous, because they carry the miasmatic poison germs suspended in them, hence at this time it is perilous for animals to breathe them.

It may be asked, "Why are not the mists on the hills also injurious?" Because these are not charged with the results of drainage and putrefaction, and besides they are simply formed by the vapour of the atmosphere being condensed against the cold tops of the mountains, and are quite different from those coming from swamps and marshes. Of course if there are swamps and marshes on mountains or high plateaux, such ground may be dangerous as well as that of valleys.

There is a vapour sometimes in the mornings about Curry's Post, where, Mr. Curry informs us, Horse sickness, unless contracted elsewhere, never occurs. Here, however, the vapour is that of hills, for it is said to be one of the highest points of Natal. We would not be understood as saying that all wet or swampy ground is unhealthy, it would be unreasonable to think so, but at the same time we should avoid leaving our horses or mules in or near such places at night.

But Horse sickness occurred last season on the rather high ground of Fort Napier, and how is that to be accounted for? Because that ground is, we think, for horses, foul ground, and besides Fort Napier is not really high ground; it is only higher than the low-lying and notoriously Horse-sickness-producing ground around it.

But why is ground that readily gives horses this disease not also injurious to men? Such a state of things as ground or locality being injurious to one kind of animal in one region and not affecting other kinds is common, just as this disease, Anthrax, in one region attacks one species of animal, while others escape, which readily take it in a different part of the globe.

The poison germs of Horse sickness may also then enter the body through the lungs from *foul* ground which is not necessarily marshy and swampy, or from ground near rivers and sluggish streams, pools, "pans," &c., but marshes and swamps have always been notorious for producing disease, as has also in many countries the ground near rivers. We must not therefore fall into the error of supposing it necessary that ground must be marshy to be malarious, for experience shows us all over the world that it may be so without stagnant water being present, but as a rule we find miasma where there is marshy ground or stagnant water, with decaying vegetable matter.

During the last wet season in Natal an extraordinary quantity of rain fell, and Horse sickness was more destructive than had been known for years, and especially so about Pietermaritzburg. A great quantity of rain loosens and softens the soil, which being subsequently acted upon by the heat, emanations are developed and get liberty to rise in the air. Such experience, after very much rain, succeeded by great heat of weather, is common to all countries where Anthrax prevails; and it is a practical fact, that in this country Horse sickness, *like Anthrax in other countries*, is everywhere more prevalent after a remarkably wet season. The wettest season in Natal is January, February, and March. All accounts here agree that Horse sickness is most prevalent after a very wet season.

Prevention.

What do all these things teach us? They tell us in the most forcible manner that Prevention is much better than cure, and they urge us to take steps to place our horses and mules during the sickly season as much as possible out of the reach of the soil-developed poison, *especially during the night and early morning*, for these are the most dangerous times when the foul poison germ-charged mists and dews are concentrated, and are not dispersed by the life-giving sun. When we can do this, as we often can, without interfering with the animal's daily work, it is an act of folly not to do so. If we do not, we cannot blame anyone but ourselves. If we have any number of animals, and some begin to be attacked by Horse sickness, we ought *at once to remove the rest to fresh ground*, and it should be if possible high and dry healthy ground, the higher the better, for these soil-developed poisons appear only to be able to rise a certain distance from where they are usually produced.

One of the most valued practical remedies in countries where Anthrax is more common and more studied than here, is a change of attacked animals to fresh ground, and a move of the affected flock or herd of even a few hundred yards has often cut short a violent outbreak of the disease. It must not be thought that the removal is a failure because a case occurs during the first day or two afterwards, because it may have been contracted on the old ground. But if cases continue after the first two or three days another move should be made. We witnessed the great value of these recommendations this last season in Pietermaritzburg; but in Natal people frequently appear quite satisfied to make no change and do nothing, as if Horse sickness were

some mysterious and unknown disease, whereas, as we have before said, it is only a variety of a malady which has everywhere attracted much attention, and which is more widely diffused than any other with which we are acquainted.

We saw last season here a most destructive attack of Horse sickness cut short by moving the animal less than three-quarters of a mile to very much higher ground, whence they did their ordinary work. With reference to this, we may again profitably say that it is most important to place the animals high enough to be out of the reach of the poison during the *most dangerous time, the night and early morning*, and also where such winds as there may be may have free play, so as to keep the air free from poison germs. The animals can come and work in the low ground and towns during the day. The explanation for this we have already given.

We can readily conceive that, the poison being living germs—or, in other words, finely divided solid matter—it can probably only be carried in any quantity to a certain height in the atmosphere. "It is generally understood that an elevation of fifteen or sixteen hundred feet above marshes preserves animals from their influence, *but this differs very much in different regions*. At Rome, for instance, it is sometimes found that an elevation of one or two stories will preserve human beings from the ill effects of malaria; while at Vera Cruz, safety is not assured at less than two thousand feet above the malarial level."—*Fleming's Veterinary Sanitary Science and Police*, Vol. I. The celebrated Professor Tomassi-Crudeli attributes the malarious fever, or Roman fever, as it is commonly called, to the presence of an organism to which the name of *Bacillus Malariæ* has been given.

It appears to us exceedingly probable that all, or nearly all, of our so-called specific diseases, of which small-pox, measles, scarlet fever, typhoid fever, ague, cholera, diphtheria, &c., are examples, will be found to be depend upon living poison germs, and we believe the discovery, for most of them, to be a question of no very long time.

Where it is inconvenient or impracticable to change the situation of animals, as those working in towns, they should be fed during the sickly season on dry foods—oat forage, mealies, bran, &c., and no wet or freshly cut grass, or, better still, no grass at all should be given. Horses and mules should also be kept from feeding on the "flats" or low-lying places while the dew is on the ground, and they should not be allowed to *feed on or near notoriously bad places at any time* during the Horse sickness season. If horses must be grazed, they should not be turned out until the sun is high and the dew is *all dried* up, and they should be brought up some time before sunset. This plan can be easily followed with farm horses. "The best plan with brood mares and those which are 'running' on the veldt is to take them up to the highest possible healthy ground during the sickly time."—*Browning*.

It is obvious that if animals are in stables or buildings located on or surrounded by foul, or swampy, or marshy ground, or close to slow-running streams, they must be very liable to contract Horse sickness during the sickly season. Such ground should be avoided as far as possible for camps, as also ground near rivers, sluits, ponds, "pans," &c., if unhealthy looking.

We would then in the most earnest manner advise those who have horses or mules which they value to move them from dangerous situations, and especially if they have attacks among herds of animals. A height of a few scores or few hundreds of feet—the higher the better—may make an enormous difference, but even if there be no high ground, an immediate change to a fresh and healthy situation is most desirable. Grazing should not be allowed near the graves or bodies of animals which have perished from Horse sickness or Anthrax, and the carcasses should be so disposed of as to avoid risk of infection from them.[1]

Recently we drove all along the road to Newcastle and back, and lost no opportunity of making enquiries from those likely to have experience about Horse sickness whom we met on the road, or coming from, or going to the Free State and the Transvaal. Their experience without exception coincided with the above arguments, as does also that of very many other stockowners with whom we have conversed on the subject in different parts of the country. Now, than this, it appears to us there could be no more conclusive evidence that Horse sickness is a soil-produced disease.

We are informed that Weston, Mooi River, is a place free from Horse sickness, unless the animal has brought the disease from elsewhere. People at the "Thorns," which are low-lying, send troops of brood mares in the Horse sickness season to Weston, so that they may avoid it. They send so many, says Mr. Taylor, that between Mooi River and Harding's they were "thick," and that for sixteen miles below Weston the ground is healthy, but further on Horse-sickness occurs. Above Weston there are lots of swamps, but the very cold winds of the Drakensberg sweep over them, and very probably clear away or kill the germs of disease. All the ground from Karkloof to Bushman's River Hill, about nine or ten miles, and from the Drakensberg to about ten miles below Weston, is healthy, that is, a district about twenty miles wide and fifty long. We give the above as one instance out of very many that have been furnished to us, and we may also add that at Lydenburg they cannot keep horses in the valleys in the sickly season; they put them for safety on the hills; so it is near the Biggarsberg and numerous other situations.

It is a popular opinion that Horse sickness disappears after the first frost, but this is erroneous. The first few frosts certainly very greatly diminish it, but this year we had many undoubted cases in and around Maritzburg, which occurred subsequent to the first, and, in fact, several frosts. We account for the frost, or rather the cold, subduing Horse sickness by its killing most of the poison germs which cause the disease. We stated at the beginning of the paper that the scientific term for this parasite is *Bacillus Anthracis*. Another name for the organisms which cause Anthrax is Bacteria. M. P. Miquel has recently stated as a result of his investigations, *Journal Chemical Society*, quoted in the "*Veterinarian*" for January, 1881:—"The number of Bacteria present in the air is very small in Winter, increases in Spring,

[1] Veterinary Surgeon, 1st Class, Duck, who has had a long military experience in Natal, informs me in a letter from that country, this year, 1884, that he now considers the stopping of all grazing in the sickly season to be, when it can be effected, the best practical measure of prevention.—*J.L.*

is still higher in Summer and Autumn, and decreases rapidly during hoar frosts."

Incubation, or Hatching of Horse sickness.

From the remarks above made, that Horse sickness is unknown in some districts unless the horse has brought it with him, it will be understood that the disease—after the poison germs have been introduced into the system—has a period of incubation or hatching. This means that the poison germs during this seemingly quiet time *rapidly* multiply themselves until they become so numerous that they most injuriously affect the blood and consequently the whole system. This hatching is sometimes of short duration, perhaps only a day or two, but oftener it is longer, three or four, or more days. The longest period recorded in Anthrax is twelve days. After direct or experimental inoculation the disease is from twelve to thirty-six hours in showing itself. Of course direct inoculation produces it more rapidly than when it is contracted in the ordinary way.

In a recent paper on Horse sickness, by Mr. Duncan Hutcheon, Colonial Veterinary Surgeon, Cape Colony, which appeared in the English "*Veterinary Journal*" for July, he narrates the inoculation of two horses and of two goats with a small quantity of the blood from two horses which had died from Horse sickness. The inoculated animals in a few days died. More experiments in this direction will perhaps soon be made.

While alluding to inoculation, it may with great advantage be related here that the celebrated French professor, M. Pasteur, announced at the recent Medical Congress in England that the parasitic organism, the *Bacillus Anthracis*, from the bodies of Anthrax-destroyed animals, can be so cultivated in the laboratory, in successive generations, as to destroy almost all its poisonous property. It is in this condition used to inoculate healthy animals as a protection or preventive measure, and of fifty sheep given for the experiment, twenty-five received this protective inoculation and twenty-five were left alone. In a fortnight afterwards all the fifty were inoculated from other virulently infected sheep; the twenty-five previously protectively inoculated ones suffered scarcely at all, the twenty-five others all died within fifty hours. This discovery, towards which the famous veterinary professors MM. Chauveau and Toussaint have much contributed, opens up a wide field for beneficial research in both *human* and *animal* medicine; indeed, it may revolutionize both, and be pregnant with the most important consequences to their welfare. It may be, and probably will be, applied to other contagious and specific diseases as well as Anthrax, and it may prove to be "only second in point of value to the discovery of means by which the germs of disease can be completely and totally annihilated." What a vista is here presented for experiment and hope!

Query—May not some of the mysterious diseases of sheep and cattle and fowls in this colony be Anthrax? It is not at all unlikely, especially in sheep.

Symptoms of Horse Sickness.

A horse or mule often goes to work or exercise apparently quite well,

and after being out for a time—the exercise would seem to stimulate the development of the disease—he suddenly begins to "blow," that is, to breathe in an alarming manner, the eyes appear ready to start out of their sockets, and in some cases there is swelling of the eyepits; the pink membrane lining the eyelids is of a deep red colour, and often has claret-coloured spots upon it. Frequently a yellowish froth, sometimes tinged with blood, comes from the nostrils, suffocation appears imminent, and, in fact, death rapidly ensues, sometimes in as short a time as ten minutes or quarter of an hour, but usually much longer. At other times the disease comes on more quietly, the horse is dull and sluggish, does not feed with his usual appetite, and there are often pains indicative of colic, the animal lying down, rolling about and pawing. These latter cases last much longer than when the disease chiefly locates itself in the lungs, not, however, as before explained, causing inflammation of them. What we may designate the colicky cases of Horse sickness, in which the disease has chiefly located itself in the intestines, may last even so long as two days.

It has just been said that death may occur in so short a time as ten minutes or quarter of an hour from the time the malady was first noticed, but it is probable that a careful observer would have detected that the animal was not previously in his usual health and spirits, and no doubt the use of the clinical thermometer would have shown by the rise in temperature that something was very wrong.

Sometimes the disease shows itself in other forms than those just described, and receives the name of Dikkop, from swelling of the head; Black Tongue, which conveys the origin of the term; and Throat Sickness, in which there is much swelling about the jaws and throat, the same as in that form of Anthrax called Loodiana Fever, which so fatally attacks horses in India.

In some countries and in some animals external swellings and tumours are often seen in cases of Anthrax.

We may add that in the sickly season many fatal cases are by the unskilled erroneously attributed to Horse sickness, which is a convenient explanation of the cause of death.

It should here be remarked that—in so far as it goes—his excellent Report on Horse-sickness, which appears in the *Natal Almanac* for 1879, Mr. S. Wiltshire, Colonial Veterinary Surgeon, identified the disease as—what it is—Anthrax.

Treatment.

Various are the nostrums and so-called remedies for Horse sickness, but it is not our intention to here enter deeply into the comparatively unprofitable subject of treatment. Our great object in writing this paper is to advocate rational measures of Prevention.

The disease is usnally so far advanced before it is detected that medical treatment only too often affords little ground for hope, and especially so if there is much frothing from the nostrils, which, unless it speedily ceases, will quickly suffocate the animal. But while there is life there is very often hope, therefore we should persevere and do what we can.

The treatment we are most in favour of, which we have found most

successful, and which can be scientifically defended, is the administration, three times a day, of one drachm to one drachm and a half of No. 2 Carbolic Acid, in a pint of cold water. At the same time, the animal must be placed in a comfortable situation, with *good nursing* and sanitary arrangements, and food and drink suitable for a sick animal should be given. In all cases we should advise, when practicable, hot fomentations, by means of rugs dipped in the water and applied to the chest and abdomen. The water must not be made so hot as to scald or inconvenience the patient. We do not recommend blistering these parts.

Salted Horses.

A paper on Horse sickness would be incomplete without saying that horses and mules become what is here termed "salted," which means that either from having had an attack of the disease, or from being long acclimatized, they are not liable to take it. There is nothing wonderful in this; we see the same protection conferred in many different diseases, especially of mankind. Some individuals will not "take" a disease, however much exposed to it, and some will only contract it in a mild and transient form. Numerous instances have occurred where *so-called* "salted" horses have suffered a supposed second attack, but we do not know whether these animals had really been previously affected by Horse sickness, and as a better price is thereby obtained, it is not impossible that some animals are erroneously described as "salted." It is remarked by many that salted horses often have an unthrifty appearance, and our belief is that many horses and mules pass through the disease *in so mild a form* that it is scarcely, if at all, noticed by those attending them.

Concluding Remarks.

It is hoped that what has here been written may be sufficient to dispel some of the apathy and despair which have hitherto existed about Horse sickness, and that the practical and, in other countries, well-known preventive measures we have described may be adopted here, and especially so as little or no interference with the animal's work is thereby produced. If we will not use rational measures to prevent disease, we cannot be surprised if we suffer for our neglect.

A very famous Veterinary Surgeon, Professor John Gamgee, whose reputation is world-wide, has recently written :—"Mystery in relation to animal plagues is a convenient word with which to cloak ignorance. The plagues of the world are fast becoming the best understood of all diseases. Their prevention can surely be obtained by scientific methods, strikingly in contrast with the means of cure so advantageously and now so wisely regarded as of secondary importance."

We beg to commend these pregnant words to the consideration of all who are interested in the well-being of South Africa. After a practical acquaintance with many countries, we know none where the prevention of disease among the domesticated animals is so much neglected as in Natal and the neighbouring States, and where such enormous losses are annually incurred through disregard of the simplest and most obvious precautions.

THE RANGE-READER.

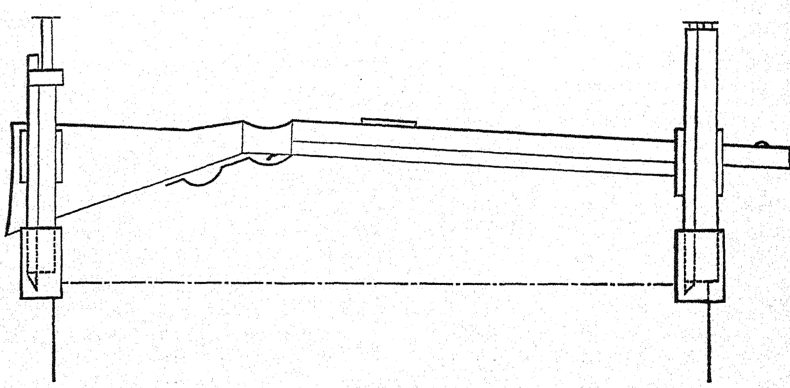
BY

LIEUT.-COLONEL P. NOLAN, LATE R.A.

THIS brief account of a new instrument for determining distances is submitted in compliance with a wish expressed by the Secretary.

The general design has been to construct an instrument of sufficient accuracy and solidity which would occupy no additional fighting space, and which gives the distance of a shooting line as quickly and as simply as a rifle or a gun can be aimed.

The instrument as it is now made employs a 3 ft. 8 in. base, little boxes being attached to a rifle into which two parallel telescopes can be instantaneously slipped. The stock telescope contains a needle in its focus, and is an ordinary erecting telescope. The muzzle telescope has a well-numbered scale in its focus.



PLAN OF A RANGE-READER ON A MARTINI-HENRY RIFLE.
Chain dots show lines of sight. Plain dots show inside of guards. Details are omitted.

When the rifle is placed on a bundle (the valise), and the point of the needle is brought by moving the rifle on any object, say, a man's head, the man's head appears at the true distance on the scale, where it is read off; hence the name. This supposes the two telescopes to be parallel.

The parallelism is thus assured. A very small telescope is attached to the stock main telescope, with a notch or nick in its focus. A

similar telescope is attached to the muzzle main telescope with a vertical hair in its focus. These small telescopes see into each other because both have prisms in front of the object or front glasses. When the vertical hair appears in the centre of the notch it may fairly be presumed that the probable error in parallelism of the main telescopes does not exceed $\frac{1}{200000}$ of an inch per inch.

Now as to mechanical details. The wire will not stay in the notch for five minutes on a hot day nor always after a smart run, but it moves out so little that it can be put back in a second. There are three other adjustments sometimes required; for the parallelism of two telescopes cannot be made by a single movement, but as these may be 500 times as coarse as that of the notch no one of them need be rectified during a defence or even during an ordinary attack. They might by the help of exquisite workmanship be altogether got rid of, but it is thought better to keep them in reserve. The notch adjustment could not easily be dispensed with, as the rifle bends from its own weight and from the sun. The means for testing are perfectly novel. The stock telescope is brought close up to the muzzle, and then an ordinary observation is taken on a point a couple of miles off. As the base is now very small it goes out, and the distance reads infinity on the scale if the range-reader is in order; if it is not, the focus-needle is moved until it does. The instrument can also be tested at a short distance by putting up a stick of the breadth of the small base. The instrument rarely requires this correction, as it has no moveable part which affects accuracy of observation.

Out of 86 observations taken on 5th November, at Hythe, some by two sergeants, and some by two privates, on a man, each observation occupying a maximum of two seconds—

40 were under	10 error.
24 over, 10 under	20 "
13 " 20 "	30 "
9 "	30 "

The following, on the 7th November, was slightly over an average sequence; time 3 seconds or 4 seconds; object, a man.

Distance.	Error of Privates Duncan & Finlan.	Error of Sergeants Williams & Denison (Hythe.)
305 yards	5	5
425 "	5	15
515 "	5	0
560 "	10	5
620 "	10	0
730 "	0	0
780 "	5	10
670 "	0	10
580 "	5	0
540 "	0	10
485 "	5	0
375 "	5	0
395 "	0	5

Another set taken on 6th November, by Sergeants Williams and

Denison, in 3 seconds, is given, because it was taken in a gale (wind, 6) with slight rain; object, a man.

Distance.	Error.
340 yards	0
430 "	0
520 "	10
610 "	10
680 "	10
780 "	5
620 "	5
480 "	10
370 "	0
260 "	0

All the Sergeants' observations (during instruction) recorded at distances over 500 yards were 118, of which 64 were under 10 yards error in all the observations; the distances were unknown to the observers.

3 seconds was the usual maximum time, sometimes varied to 2 seconds or 4 seconds.

Ranges over 800 yards could not be very conveniently tested at Hythe, so few were taken there.

The errors at 1400 may be deduced from those of about 700, by multiplying by four.

Although greater accuracy and rapidity has been since obtained, the following table is given as official:—

Woolwich, 9th August.—Point of observation, a man; wind, nearly 5 (half-gale). Observers, Corporals White and Porter, Wiltshire Regiment.

Distance.	Error.	
510 yards	10	
610 "	0	
666 "	10	
740 "	20	
800 "	0	
980 "	80	
360 "	5	
300 "	5	
450 "	0	
660 "	30	
330 "	0	
610 "	10	
610 "	10	A maximum of 5
510 "	0	seconds was allowed
560 "	20	for these six observa-
450 "	0	tions; the observers
300 "	5	stated they had prac-
330 "	0	tically 3 seconds.
710 "	10	
795 "	25	
880 "	20	
980 "	20	
910 "	60	
1010 "	10	

For the following observations (also official) an 8-foot base was substituted:—

Distance.	Error.
1000 yards	8
1200 "	0
1100 "	20
1400 "	20
1300 "	20
1500 "	20

The advantages claimed are—

Small base.
Great quickness.
Non-necessity of identifying the man observed.
Perfect system of testing.
Superiority to wind.

In addition, the method of observation is peculiarly simple and like the aiming of a rifle; as it generally consists in pointing or aiming only; even where the correction of the parallelism is required, this demands but a single movement, and is not nearly as difficult as fixing an angle.

The weight is $3\frac{1}{2}$ lbs., reducible to 3 lbs. If a case is carried, this would weigh $\frac{3}{4}$ lb. extra. A special support weighing $\frac{1}{2}$ lb. used with the help of a bayonet and loading-rod constitutes an admirable rest for either attack or defence.

The Infantry size alone has as yet been constructed, but instruments suitable to Artillery can be made by a simple change of dimensions, with about 8 times the accuracy for field, and 20 times the accuracy for naval or coast purposes.

BATTLE FIELDS

IN THE

LE MANS CAMPAIGN.

BY

CAPTAIN R. F. JOHNSON, R.A.

No. 8.

CHANGÉ.

10th & 11th January, 1871.

A WALK of 25 minutes northward from the Changé station of the steam tramway on the Parigné l'Evêque road, brings you to the village, the site of the fiercest fighting in the battle of Le Mans.

The country to the west and north is a low ridge covered on the top with large fir forests, and on the lower part of the slopes with orchards and market gardens of considerable size, and is fairly open; but to the east, where the fighting took place *on the 10th* of January, the ground is flat and divided into very small enclosures, all of which are surrounded by tall thick hedges, containing numberless poplar trees. The field of view consequently is almost *nil*, and it is difficult to follow the phases of the battle.

A study of the combat, however, on the ground is especially useful and interesting to Englishmen, for by it is seen what can be done in a very enclosed country, much resembling many parts of England, by troops no better drilled and worse armed than our volunteers. The Chassepôt, of course, is a better weapon than a Snider, but Chanzy's levies were armed with no less than fifteen different kinds of rifles, and a Snider can shoot accurately for any distance that can be seen over in this kind of ground.

During the night of the 9th and 10th January, a German Division bivouacked, after fighting, at Ardenay, 7 miles from Changé, and in the morning at 10 a.m., sent forward towards the latter village $5\frac{3}{4}$ battalions, $\frac{1}{4}$ squadron, and 6 light guns, while the remainder moved

due west along the Le Mans high road towards Yvré l'Evêque railway station at Lune d'Auvours.

The French held the ridge in rear of Changé in strength, had 2 battalions in the village and a line of outposts from Le Pavillon farm, (half a mile to its south-west) past La Girarderie Chateau and Les Gars, (nearly 2000 yards to the east) to Auvigné Chateau, (1200 yards north-east) whence it extended by Les Pelliéres farm, through the woods to the north to Yvré l'Evêque station.

Snow was falling and the day was very cold, and the German march in consequence very slow. The column passed from the valley of the Narais river into the low ground to the east of the French position by the gap between the Loudon Forest and Rossay ridges.

At about half-past two the fight commences; the head of the German column having run up against some scouting parties 2 miles to the east of Changé, so that their 5 mile march has occupied 4½ hours.

At 3 p.m., a Battalion is hotly engaged with the defender's outposts in a combat, which sways backwards and forwards, on the Les Gars "Heights."[1]

The French finding their outposts maintain their ground, send forward the two Battalions from Changé, one to Gué La Hart, about 1 mile from the village, and the other on its right. They are replaced by three other Battalions, one of which immediately enters the centre of the front line, and another occupies Auvigné Chateau and its grounds.

The fight is now very hot, and the Germans can make no headway until deployed, which takes time in a country where the roads are regular defiles, and where, when one hedge is passed another lies 100 yards in front.

The German Battalion is reinforced by half another, while 1¾ are dispatched towards Auvigné Chateau on the right, and another Battalion to La Goudrière farm on the left, down by the Gué Perray brook. All attempts to use the guns prove useless, and the Infantry has to fight alone.

By 4 p.m., an hour-and-a-half after the commencement, the Germans have half a Battalion across the brook near La Goudrière, 2 Battalions in the centre, 1¾ advancing on Auvigné Chateau and 1½ Battalion in reserve, in all 5¾ Battalions or about 4,600 men on a front of 1300 yards. At this hour their line receives a sudden extension to the left (S.) by the first arrivals belonging to another Division which has been engaged during the morning at Parigné l'Evêque, 5 miles distant. This party consists of 2 Battalions, some pioneers and 6 guns, and quickly carries La Girarderie Chateau with half a Battalion, occupying the farms south-east of Gué La Hart with the remainder.

After half-an-hour a fresh impetus is given to the advance by sending a half Battalion of the reserve into the centre of the line, and a general advance is sounded. Two and a half Battalions attack Auvigné Chateau, and a quarter of one reaches the frozen brook. A counter

[1] English translation of German official account.

attack, repulsed by file firing, checks the advance for a few moments, but another quarter of a Battalion dashes forward with a cheer, and the Gué La Hart bridge and the line of the brook throughout are in German hands, while Gué la Hart itself is captured by the troops on the left after a stubborn resistance.

It is now dark and the fighting is stopped, while some order is introduced among the broken units and further plans are decided on.

At 5.30 p.m. the din of battle again begins on the extreme left (S). It is the attack of fresh German troops. A strong column of $3\frac{1}{4}$ Battalions, 1 Squadron, and 12 guns of the Division which has been engaged at Parigné l'Evêque has marched along the high road to Le Mans, but has found it blocked by strong Batteries in the French position. Accordingly, hearing the firing near Changé, it has left one Battalion to guard the road near Chef Raison Chateau, and turned off along the lane which runs from Changé to the east by Boyère farm. A quarter of a Battalion with the guns goes to join the other troops at Gué La Hart, three-quarters of a Battalion occupies the farms on the line of advance, and one and a quarter Battalion attack Changé at 6 p.m.

The French in the village have just been dismissed, thinking the action finished, when they are suddenly called on to repulse this unexpected assault; some of them pour a volley into the Germans as they rush across the bridge, and then commences a street fight, out of which the assailants come victorious, but not till after an hour's hard work.

No sooner has the battle again died out, than it recommences on the Gué La Hart road, where the Battalion which has been held in reserve by the Germans has been sent forward, in ignorance of the success of the left, with the hope of completing the advantages already gained by the capture of the last-named village. On its way it has stumbled across a barricade, the defenders of which have offered a slight resistance, ignorant like the assailants of the state of affairs in their rear.

Changé is a strongly built village (2500 inhabitants) whose two principal streets meet at an angle at its eastern entrance. Except for the want of a field of fire to the east it is well calculated for defence, as the ground in front is slightly lower, and consists of marshy meadows, and the only entrance is over a narrow bridge flanked to the south by a broad deep ditch full of water and about 100 yards long, while to the north of it the ground is slightly more open, and the houses give a good length of front. Just beyond the bridge the Boyère road joins that from Gué La Hart; if the barricade had been placed at the bridge or behind this road junction instead of more to the eastward, the Germans would have had a much tougher piece of work. Auvigné Chateau, a white country house, can be seen on the left at the end of a long narrow meadow crossed by the Gué Perray brook. The ground is very slightly raised between here and Gué La Hart, about 1500 yards further east. At this place the road forks, one branch going to the right down the left of the Gué Perray stream, and the other to the left over a stone bridge and past Les Gars farm. The Les Gars "Heights" exist more in the imagination than in

reality, the site thus dignified being a broad fold of the ground about 10 feet above the level of the brook. The country is all very enclosed and scarcely any view is obtainable. The difficulty of deploying as the Germans had to do from this road is very apparent. About 100 yards east of Les Gars, a glimpse can be caught of the Auvours Heights, part of the French great position, about $2\frac{3}{4}$ miles to the north, and on the other side of the road is La Goudriére farm, and across the brook the white walls of the small Girarderie Chateau appear among the trees.

There are no lanes to the north, so it is best to return straight to Changé.

During the night of the 10th and 11th, both sides prepared for the struggle that was to take place for the ridge west of Changé. The day broke fine and clear, but the Germans delayed the attack until 11 a.m., so as to enable the troops on the main St. Calais road to the north to reach a position preventing any counter attack on the right flank from the Auvours Heights.

The French were by no means discouraged and were reinforced, the line and troops being visited by General de Chanzy himself in the early part of the day.

The German force in the village consisted of $10\frac{1}{2}$ Battalions, of which $4\frac{3}{4}$ Battalions were to remain in the Changé, while $5\frac{3}{4}$ were to move down the valley of the Gué Perray brook and attack the French left. In second line at Gué La Hart lay 6 Battalions with the guns, which latter could not be used in this enclosed country, while one Battalion held the Parigné-Le Mans road $1\frac{1}{2}$ miles to the south (left).

At 11 a.m., the $5\frac{3}{4}$ Battalions move away to the north, making a detour to avoid loss, and all goes well until they are about to wheel up to the left to begin the attack. At this moment the French threaten an attack from the Auvours Heights, and 2 Battalions have to face that way with their backs to their intended destination. As a *point d'appui*, Les Arches Chateau, a large country house near the Huisne, just round the end of the Changé ridge, is occupied by $\frac{3}{4}$ Battalion, and another Battalion for the same purpose pushes on to the rear of the ridge, and seizes Les Noyers Château and the bridge near it over the Huisne. Thus at this early stage of the battle the French right wing may be said to be divided from the rest, for the only communications across the Huisne are by a foot bridge at the mill of L'Epau and the bridge of Pontlieue. The two remaining Battalions try to do the work of all, and, advancing up the Chemin-aux-Bœufs, are soon involved in a most serious conflict, in which one of them loses nearly all its officers, and both have run short of ammunition before the pressure is taken off them by the advance of troops from Changé, and by help arriving from the north.

At 1 p.m., the troops in Changé, being joined by the 6 Battalions from Gué La Hart, send forward 3 Battalions, supported by $1\frac{3}{4}$ more, straight against the French position. The slope is not steep, but the crest is entrenched, and no view can be obtained of the numbers engaged, or of their movements.

The fighting is very stubborn, but at 2 p.m., several farms have

changed hands, and the German line runs from Les Noyers Chateau through La Landrière and the knoll just west of Le Pavillon to Le Grand Anneau.

The French are continually receiving reinforcements, and the German right can scarcely withstand their onslaught, when it is in its turn strengthened by the arrival of 2¾ Battalions, who have been set free from watching the French to the north and from occupying Les Arches Chateau by the approach of 3 Battalions from the St. Calais high road. At the same time ½ Battalion from Les Noyers attacks the French in flank.

The reinforcement from the north has to re-take Les Arches Chateau, which has been re-occupied as soon as evacuated, and some guns open on the French Batteries across the Huisnes, but find, as another Battery has earlier, that it does not pay to fire at guns of position posted in commanding situations.

At 3 p.m. it is the turn of the German left to be pressed, and it loses Le Grand Anneau farm, driven back by an impetuous charge of 4 French Battalions, who only arrived from the south-west in the morning, and have advanced by the Pontlieue-Changé road. The Germans on the right gain a little ground, while the French replenish with ammunition, but again the tide of battle sets against them for a time.

Favoured by the cover of the hedges, &c., a Battery of 6 guns manages to get into action against Le Tertre at a range of 800 yards, and another Battalion is sent in the same direction, but the half of it trying to reach the farm cannot debouch from the copse near it.

At 5 p.m., a Battalion on the German left has to be withdrawn, having no more ammunition, but it is replaced by two fresh ones advancing from Changé along the Pontlieue road. Half a Battalion moves along the road and a Battalion joins the troops against Le Tertre.

It is now dark, and German discipline and drill begin to tell, while the effects of the Chassepôts and Remingtons rapidly decrease. One and a quarter Battalion made up of various companies penetrate into the buildings of Le Tertre, and a quarter Battalion with a rush capture two guns at the crossing of the Chemin-aux-Bœufs and the Pontlieue road. The French make a gallant attempt to re-take their pieces, but the Germans are victors after a close hand to hand fight. On the right the fortune of the battle has favoured first one and then the other side, but in the end the German line passes close by La Landriére.

To see this ground take the good road leading out of the village to the north and keep round the end of the fir-clad spur by the road leading to Les Arches Chateau, by the south side of the Gué Perray brook. It will be seen that the slopes just west of Changé are not thickly wooded, and that the crest is not more than 30 feet above the village. When the end of the ridge is turned the country to the north is thick wood as far as the foot of the southern end of the Auvours Heights. The ground in the Huisne Valley about Les Arches Chateau is cultivated, but there is a good deal of timber. Turn left (S.W.) along the Chemin-aux-Bœufs, a simple sandy track through fir

woods. It was up the hill that the 2 Battalions of Germans, which first began the battle of the 11th January, had such a fierce struggle, while the remainder of the turning force faced the threatened attack from the Auvours Heights, under the fire of Batteries of position on the commanding western bank of the Huisne valley. The track runs through woods until almost behind Changé, when the slopes towards the village are fairly open, and the strip of ground on the left (E.) as far as the extreme crest (about 200 yards) is cultivated. On the right are dense fir woods covering all the top of the ridge and its north-western slopes down into the Valley of the Huisne. The gateway of the drive to the Les Noyers Chateau is passed on the right and some cottages on the left, just beyond which is the top of a small side valley running to the westward. Due west of Changé a junction of several tracks is reached, which in the map of the battle is marked as a simple cross road. La Landrière, a cottage, lies on the left (E) 200 yards off by the track leading to the village. The reason why this marked the German line at the end of the battle is given by the presence of a ridge placed as it were askew on the top of the main one, which was more than the tired and exhausted troops could carry, while the French held firm. Continue straight on south-west, and on the left of the track on the end of this cross ridge, just beyond a knoll, a capital view of all the country eastward can be obtained. Changé lies 1500 yards distant at the foot of the slope which is here covered with market gardens and orchards. Immediately on the right front is Le Pavillon, a fair-sized house in the hollow, down which runs the Pontlieue-Changé road. The low ground to the east and south-east is so full of hedge-row timber that it looks like a forest, and is bounded by the Loudon Forest ridge, 4 miles off, and the Rossay and Beauvais ridges which end 2½ miles to the north-west. Parigné, marked by a bright red roof of a building at its top, can be seen 6 miles to the south-east, and the ridge on whose northern end it lies, bounds the low ground in that direction. The whole view very much resembles that from the Hartford Bridge Flats, looking towards Aldershot.

Continue along the Chemin-aux-Bœufs to where it crosses the Changé-Pontlieue road, the point at which the French guns were captured just as night fell.

The road from Changé to the steam tram station can be reached either by the Changé road or by the small lane leading past Le Tertre farm. By taking the first, the position of the German Battery which took part in the last incidents of the fight is passed, and it will be seen how the ground made its advance to within a range of 800 yards possible. The wood about this point was probably not so thick in 1871.

The whole walk from Changé tram station and back to it again is 7 or 8 miles.

(*To be continued.*)

HANDBOOK OF ARTILLERY MATÉRIEL.

BY

CAPTAIN F. C. MORGAN, R.A.[1]

A REVIEW.

BY

MAJOR G. MACKINLAY, R.A.

THIS small book contains, in a concise form, information on ordnance, ammunition, carriages, explosives, and a certain amount on repository exercises: in fact, it may be said to be a précis of the Royal Arsenal Treatises, and also in part of the book on Gunpowder and the Siege Artillery Manual, with the important addition that it is well brought up to date: its appearance at the present time is opportune, as (although the new R.G.F. Treatise will shortly appear) the Arsenal books are all out of print, and the others are deficient of descriptions of the newer stores.

This handbook, we think wisely, only gives a slight account of manufacture, but the matériel is described and the methods of using it are clearly explained. Captain Morgan's position as an Instructor to Officers of the Auxiliary Artillery has given him experience in conveying information, and doubtless many Officers of the Regiment, as well as others, will find the new ordnance, ammunition, and carriages described in an intelligible manner. Some readers may, perhaps, complain—a fault seldom found with military books—that it is somewhat short: in places fuller explanation might perhaps be given, specially when dealing of things which are new to many readers, but the numerous excellent diagrams enable the descriptions to be condensed, and much information is given in a conveniently-arranged tabular form.

The book bears evidence of careful revision, but it is hardly to be

[1] 108 pages, with 19 pages of diagrams, $7\frac{1}{2} \times 5$ inches. Clowes and Sons.

expected, covering as it does such a wide field, that it can be quite free from inaccuracies, as, for instance on the second page, where it is stated that the steel tube of a R.M.L. gun, if unduly strained, though it might split would never stretch permanently.

Among the matériel described, most of them with diagrams, which are not yet to be found in the Arsenal Treatises, but are only scattered through the "Changes of War Stores," &c., may be mentioned the following:—The 7-pr. gun of 400 lbs. Sections of polygroove rifling, B.L. as well as M.L., or as they are now called M.B. and M.M.—Maitland breech and Maitland muzzle-loading. 6-inch B.L. gun, Mark III. Prism.[2] powder, together with a made-up cartridge. C.[2] powder. New 9-inch Palliser shell for M.L. Common and shrapnel shell with Vavasseur driving-band for B.L. Vent-sealing friction-tube and primer. The overbank lattice-work carriage for 40-pr. The removeable cross-head for vent and safety-shutter arrangement for firing the heaviest M.L. guns with axial vents, and the hydro-pneumatic carriage for the 6·6-inch gun of 70 cwt.

It will, we think, be generally allowed that Captain Morgan has done good service in bringing out this handbook, which clearly describes many important stores, &c., which so few have yet had an opportunity of employing.

NOTES ON

ENTRAINING ARTILLERY.

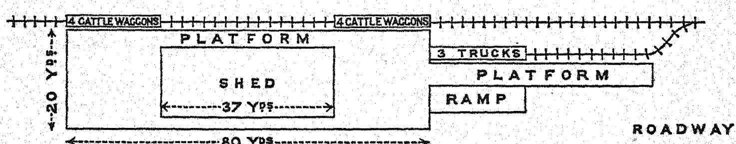
BY

CAPTAIN E. S. MAY, R.A.

THE following account of some experiments in entraining Artillery, conducted at Gwalior Station, on the Scindiah State Railway, by two Field Batteries from Morar, with the 9-pr. equipment; together with a few notes on the subject, and extracts from the Indian Transport Regulations, may prove useful.

There were eight cattle wagons available for horses, 19 feet long by 8 feet 7 inches wide, entered in the centre by a door with a flap-opening, which was 4 feet wide. The horses were placed three at each end with harness on, facing inwards, and were kept in their place by two stout poles of bamboo, termed "breast bars," across the wagon in front of them about 4 feet from the floor. There was thus a lane about 4 feet wide between the horses heads for the drivers. Four horses might have been placed at each end of a wagon without their harness; with harness on there was comfortable room for only three.

The following rough plan will show how the wagons and trucks were placed with regard to the platform :—



There was a shed on the platform which prevented the cattle wagons being formed in one continuous train, and necessitated their being separated into two divisions of four cattle wagons each on either side of it. The floors of trucks and wagons were about one foot above the level of the platform.

The three trucks on which the guns and wagons were placed were "end-loading," "low-sided" trucks; and as there was a siding for them, the entraining of the guns, &c., was an easy matter. The

trucks were 19 feet long and $7\frac{1}{2}$ feet wide; they were run down the siding up against the platform, and their ends were lowered on to the buffers.

The Battery was drawn up at half interval on an open space close beside the platform. The teams drew the guns and wagons up the ramp on to the platform, and were then unhooked; the carriages were run on to the trucks and the horses placed in the cattle wagons.

The trucks were found to take four pair of wheels, or one sub-divison complete, and the carriages were loaded in the following manner:—A gun was first run muzzle foremost down the whole length of the three trucks, and was placed at the end of the last truck, with the trail resting on the floor; its limber, shafts leading, followed, and the shafts were elevated over the gun carriage, and the wheels interlocked. Next came the limber of the wagon with the shafts to the rear. It was run close up to the gun limber, and the wheels were again interlocked; then the wagon body, perch leading, was run on to the truck, and it was placed close against its limber, with the perch resting on the floor. The shafts of its limber were elevated while it was being run on, and were made to rest on its boxes; the end of the truck was then raised, and secured, and the carriages securely lashed to the truck and one another. The end of the truck next to it was then also raised, and a similar process pursued with regard to it, and so on until three guns and limbers, with their three wagons and limbers, had been placed on the three trucks. From the time the word was given to commence, 15 minutes elapsed before the carriages were securely placed on the trucks and lashed.

Meanwhile a party of 12 gunners, and the drivers, were engaged in entraining the horses. Plenty of grass was first strewn on the floors of the cattle wagons, and on the flap-openings of the doors. The horses were placed together as they went in draught as far as possible, each cattle wagon thus taking one team; but if a horse was very troublesome he was left till the last, and another put in at once in his place. The majority went in quietly enough, but one or two gave much trouble; these were left to the last, and were bundled in by main force from men pushing behind. This was found far more efficacious than hauling them in by means of a rope or surcingle round their quarters. The operation of embarking thus 48 horses, three guns and limbers, and three wagons and limbers, which was all we had rolling stock for, took, in the case of the first battery that tried, 32 minutes; and in the case of the other battery, which had profited by the experience of their predecessors, $19\frac{1}{2}$ minutes. When the horses were all in they got half a feed of gram each, and very soon seemed quite at their ease.

After an interval, the word to disembark was given, and the time that that operation took was also noted. One Battery moved off 13 minutes after the word "disembark," and the other in 12 minutes. With a little practice, doubtless, these times would have been considerably less. There was no loading board at the station, so two stout planks, built up with bricks underneath, were placed at the end of the trucks, and formed an inclined plane for the wheels of the

carriages. It was not found necessary to lay planks over the spaces between the trucks, the ends being let down on the buffers formed an excellent roadway.

The horses heads were fastened to two bamboo poles (breast-bars), which, as has been already mentioned, were placed across the cattle wagons in front of them. There were at the station wooden troughs with hooks attached, which could have been hung on these poles, and would have formed a most efficient manger for feeding on long journies.

The following facts should be noted in loading Artillery carriages :—

1. The lashing and scotching of the wheels should be particularly attended to. Scotches should, if possible, be nailed to the floor of the truck.

2. The carriages should be brought as near the trucks as possible before the horses are unhooked.

3. No part of the carriages should be allowed to extend beyond the false buffers.

4. The load should be evenly distributed over the floor, and if any board be rotten a sleeper or plank placed across it.

5. In elevating the shafts of limbers as has been described, a drag rope should be fixed to them and kept taut, otherwise the limber may turn over backwards, and the lids of the boxes be broken.

6. When running on the wagon body the numbers must get clear of the perch in good time.

7. Hay should not be left in the trucks with the carriages during a journey.

The lashing ropes should be made fast by two half hitches to the false buffers, or to rings, if there are any for the purpose, passed round the felloe of the nearest wheel and tightly frapped. One turn should be taken round the end of each axletree-arm, inside the drag washer; the last wheel being lashed to the false buffer as before. The ropes should be kept taut, and if there are any side rings, lashings should also be taken through them and round the felloes.

The shafts or pole of a limber should never be removed until it is secured in position, for fear it may overbalance. A shaft need not ever be removed unless its point is more than 7 feet above the floor of the truck.

With end-loading trucks, the entraining of Artillery carriages as above described is an easy matter, and can be quickly performed; but with trucks whose sides do not let down, the operation is much more laborious and difficult. If a high platform is available, side-loading into trucks with fixed ends is, however, not difficult. A loading board 6 feet square is placed near the end of the truck, resting on the side, and is backed up with sleepers underneath. Sleepers, or bundles of grass, are arranged in the truck to break the fall of the wheels; and

the carriages can be placed similarly to those end-loaded, except the last one, which must be placed across the truck; and if a limber, its shafts must be removed in consequence, and the splinter-bar lashed to the side on which it rests.

If there is no platform, a ramp must be built of sleepers, or anything else that is to hand, if possible at the "dead end" of a line of rails, and the carriages loaded from it. In case there may be no platform to disentrain at, some strong skids, not less than 15 feet long, and some planks, should always be carried.

When the floors of the trucks are higher than the platform, and the sides or ends do not let down, the labour of entraining is naturally much increased, as the carriages have to be hauled into the trucks by main force. Sleepers, two against the end or side, and one in front of them, or bundles of grass, as has been already explained, should be arranged to break the fall of the wheels on the floors of the trucks.

In some trucks the doorways will be found too low to allow horses to enter with their saddles on. In such a case they must proceed without harness, and the harness is packed in a large covered goods van if available. The men must arrange their harness and appointments in a regular manner on the ground opposite to the wagon that has been told off for them.

It is laid down in the "Field Artillery Exercises," that "each wagon truck will convey one gun and limber, or one wagon and limber"; but even a low-sided truck 15 feet 6 inches long will take three pairs of wheels, the larger size will take four pairs easily, as we shown. In loading a truck 15 feet 6 inches long, with three pairs of wheels, the gun is first run on trail rear, then the gun-limber with the shafts raised over the gun; then the wagon body, perch leading, which is rested on the floor between the wheels of the limber of the gun.

The forge wagon and limber (with shafts removed), and the store cart can be loaded on a similar truck, the shafts and perch pointing inwards and resting on the floor, and the limber without its shafts between the two. The spare gun carriage and store wagon (with limber dismounted) will form a load for another truck.

A platform wagon, 22 feet long, can be arranged to take five pair of wheels.

A
RUSSIAN VIEW OF THE BATTLE OF INKERMAN.

BY

CAPTAIN F. BEAUFORT, R.A.

THE following purely Russian account of the Battle of Inkerman was translated from a kind of Guide Book, sold by the priests of the Monastery of Inkerman, which also contains much curious information about the Cave-Temples, Relics, &c. The book is avowedly by M. Theodor Levanoff, "of Moscow."

On the 24th October (5th November) 1854, during the engagement, a detachment of our troops, who had sheltered themselves on the hill behind the ancient fortifications that rise on the summit of the cliff just over the monastery, being perceived by the enemy, the Monastery was subjected to a violent fire, and suffered considerable damage from the bullets and shells. The injuries inflicted on it by the enemy, on the church itself, and on the outer cliff walls, remained unrepaired for a long time. The following is the description of the Battle of Inkerman by one of our travellers:—

"On this spot, during seven long hours, raged the furious hand-to-hand contest. This terrible valley became the tomb of thousands. The 24th of October was a terribly instructive day."

One does not need to be a specialist to understand the fatal errors committed that day. As for exploits *à la Sawaroff*, with marches of 80 versts (*sic!*) per diem, and those "*à la kukareky*" (at cock-crow)—let Sawaroff do this! One must not trace out the path for geniuses either by science or common sense. These men have their own special spark which, when the occasion arises, flares up, and in a moment illumines those roads to the object before them, which same roads are invisible to all others. Pauloff's force, which bore the brunt of the contest at Inkerman, only reached its position during the night of the 22nd and 23rd, in terrific rain and sleet. Day-break on the 24th had been appointed as the moment for attack. During two nights in succession the soldiers had hardly slept; one night, indeed, they passed in a most difficult march. Can it be that this exposure to rain, this deprivation of sleep, were strategically unavoidable for the attainment of success? All this was in reality the consequence of the peculiar view, with which the soldier was regarded as a being, altogether

removed from the influence of ordinary conditions of nature. The chief incidents of the engagement can be described in a few words. The plan was as follows:—

Towards the end of October, the Allies were besieging the southern portion of Sebastopol so closely that they surrounded that portion of the town on all sides, except the northern. The English camp, protected by intrenchments, was situated between the Southern and the Large Creek, on the mountainous heights, intersected with ravines, called the Sapun Hill. It was feared that the city would not be able to endure this pressure, and it was therefore determined to drive the English (*i.e.* the right flank of the Allied Army) off the Sapun Heights, and forthwith to entrench ourselves there. This was indeed necessary in the extreme, as was proved by the ultimate issue of the campaign. Should the plan succeed, the city could in that case be expected to offer a prolonged resistance, as the foe would be restricted to one side only, the south-western. The carrying out of the project was held to be practicable, with a reasonable prospect of success. As soon as it was light, Pauloff's Column, consisting of picked regiments, was to cross the Chernaya, to climb the Sapun Heights by various paths, and to fall on the sleeping foe, viz., the extreme right of the English Camp. At the same time Soimonoff's Column, which during the night had issued from Sebastopol, was to attack the left wing of the same camp. Great hopes were placed on the effects of surprise and energy, and of simultaneous attacks from two opposite quarters. The whole affair, it was thought, would be concluded before information could be transmitted to the French camp. In order, however, to deter the French and Turks from moving from their own trenches, the column Gortchakoff, 25,000 strong with 100 guns, under Liprandi, was to make a false attack on the ascents to the Sapun Heights, which were defended by the French on the line of the so-called Kadikoi Works, and the Sebastopol Garrison was at the same time to make a sortie from the "VI. Bastion." Such a bold attack delivered simultaneously from four places obviously would disconcert the foe, and give time to the colums, Soimonoff and Pauloff, who were under the orders of General Dannenberg, to carry out the *rôle* assigned to them.

But in all this, we made one grand and irrevocable mistake. We had not examined the ravines; and it was a ravine which spoilt the whole business. They say that Soimonoff was responsible for this neglect; that he confused the right bank of the thenceforward renowned Carrening Creek with the left; and finally that he rushed into the battle without awaiting Pauloff. But the profane might be tempted to ask just one question:—Why was there not with the column of Soimonoff (who had not himself been present at the last Council, and who could therefore not be thoroughly acquainted with all the details of the plan, which had *not* been reduced to writing) some officer of the General Staff—one, for instance, of those who had been concerned in the drawing up of the project? There were two columns; the locality exceedingly intricate; and the undertaking of the utmost importance. Apparently there was nothing to hinder the employment of a specialist for the work in hand, in which, moreover, one would

have thought that one at least was indispensable. At all events, the distance was so small that continual communication between the columns was quite possible, and Soimonoff's mistake might have been rectified in ample time. Such trifles could easily have been provided for beforehand. It is incomprehensible, that the column Soimonoff, in absolute ignorance of the delay, would be allowed to appear at dawn before the hostile trenches, and to make an isolated attack. It is not for the General of a detached force to guard against such unforeseen accidents; this is the business of the spirit who organizes the whole. Still, another great omission has been laid to the charge of this last individual. Neither commander had any accurate acquaintance with the locality of the fight, and yet neither received even a rough sketch of it. The player was left in ignorance of what table it was, on which was deposited so great a stake; on which was to be decided the fate of a whole army. To the Commanders the dispositions of the troops, for the ascent of the heights only, were shewn. What further was to be done? This the Commander-in-Chief proposed to point out on the spot. We look in vain from the very first manœuvre for any one single purpose or aim in the fight. Generals fought in person, throwing themselves headlong into the fire; while soldiers and subaltern officers gave orders and conducted the fight. Everything was *bouleversé*. The consequence of Soimonoff's mistake was that the whole Russian force became crowded up into one corner—on the right wing of the English camp. The continuous crush of the thronging multitudes on the ground, all intersected, as it was, with ravines, caused the various regiments to become hopelessly intermingled, and deprived the Commanders of all power, not only to make any sort of dispositions, but even to see anything more distant than a few sajeens (1 sajeen = 7 feet). The onset of our men was determined and energetic as ever; but instead of the blow of a single massive rock, it was a succession of blows of one stone after another. The total force spent in hurling them is the same, but the results by no means equal. A power, which, used as a whole, would have crushed all opposition,—its isolated blows but rebound. The regiments of Tomsk and Kolivan charging forward, drive off the English, seize the battery, and beat off counter-attacks; on them is turned the whole fury of the foe, all his regiments, all his batteries; but those of our men, who were left below, are commencing the ascent of the heights. Long do the heroes hold their ground, performing prodigies of valour. At length, bending to the force of the wave, bullets and fire, they abandon their prey, and in one confused mass, beaten back, seek safety in flight. They are heroes, they are lions; but they are defeated; and indeed it could not be otherwise. Our men below see that it is going badly with their comrades above, that the foe is aroused, that they too must climb up, and that without the aid of roads or paths, through mud, over perpendicular cliffs. That they do climb it is needless to say, wherever it is possible—in disperse order. The men of Okhota have reached the summit; they are already expected; a hail of shell and shrapnel falls around them; every piece is directed on them; they have neither rampart nor trench; the orders had been worded "Form, and await

orders!" But here was our calamity: the English not only do not await orders, but do not even give us time to "form." What now remains to be done, but to have recourse to the true Russian mode of fighting, which requires no strategical skill in its application? The Okhota regiment vies with the men of Kolivan. They drove back the English, re-took the redoubt, and established themselves in it. Again the trenches and batteries of the whole camp vomit forth on them fire and iron; again column after column hurls itself on them, but to break, to fly, and to return yet again to the charge. Long do the brave men maintain themselves; the corpses multiply; the ranks thin. But no succour comes, and the endless, aimless slaughter continues. Again are they heroes, again lions, and again are they all dispersed. Groans, imprecations, volleys, hand-to-hand slaughter, attack and flight, friend and foe, soldiers and generals, all are mixed up in one confused *mêlée* (*lit.* in a pottage not to be eaten with a spoon). The battle resolves itself into a series of hand-to-hand encounters (*lit.* fisticuffs), duels, isolated *mêlées*, totally unconnected with one another, having no object in view but indiscriminate carnage; no issue but corpses. An enemy is seen; he is shot at! A gun is perceived; it is charged! and then, whither? What next? But to this no thought is given.

The killed and wounded encumber the ravine; but especially the Stone Quary. Our confused, disordered regiments stream down pell-mell into the ravine below. The French sharp-shooters, securely screened behind the rocks, carried on the slaughter at their leisure. Not a bullet but found its billet! The hail of grape and shrapnel marked with writhing tokens the course of the retreating masses. As our retiring columns, ever pressing closer and closer on one another, crossed the narrow bridge, they became drawn out into a long thin line, which offered a terribly favourable mark to the hostile guns. The quarries were filled to overflowing with dead, wounded, and fugitives. Heaps lay piled on heaps. Such was the Fight of Inkerman!

THE ESTABLISHMENT

OF

STEEL GUN FACTORIES IN THE UNITED STATES,

BY LIEUT. W. H. JAQUES, U.S.N.[1]

A REVIEW:

BY

MAJOR G. MACKINLAY, R.A.

THIS work fills the whole of a number of the "Proceedings" of the United States Naval Institute, and is worthy of marked attention. Lieut. Jaques was a Member and Secretary of the Ordnance Board, which has lately visited the chief steel works and gun factories in England, France, and Russia, with a view to collect data necessary for the manufacture of modern steel guns in the United States. The amount of information collected is very considerable, and the deductions drawn seem to be sound and reasonable: special care has been devoted to the illustrations which are most abundant and clear.

The work shows the data (including copious extracts from books) from which six specially selected Officers[2] drew up their report and recorded their opinion, and it is a sort of running commentary on the Official Gun Foundry Board Report. There can be no doubt that the Officers of the Board possess great knowledge, and their work has been executed with much care; consequently we may regard their evidence and opinion as that of qualified witnesses and judges who state the comparative merits of various systems, and we now have an opportunity to see ourselves as others see us. At the same time, however diligent and expert these Officers may be, it must be recognized that as the new war matériel scarcely exists in the United States, they cannot have had personal experience in the manufacture or in the

---

[1] 380 pages large 8vo.

[2] Rear-Admiral E. Simpson, U. S. Navy; Captain E. O. Matthews, U. S. Navy; Colonel T. G. Baylor, Ordnance Department, U. S. Army; Lieut.-Colonel H. L. Abbott, Engineer Corps, U. S. Army; Major S. S. Elder, 2nd Artillery, U. S. Army; Lieut. W. H. Jaques, U. S. Navy.

employment of the things described; and, although the book is so full on many matters of importance, it is a question whether a practical steel maker would not rise from its perusal with some disappointment: because the details of metallurgical processes in the various establishments visited are not very fully described. Mechanical details of dimensions of hammers, cranes, and furnaces are given at length, but the exact proportion of the constituents of a charge in a steel furnace and the treatment it receives there, with the furnace manager's tests, details of annealing, casting, &c., are not so fully entered into. It must be remembered, however, that information of this kind is most difficult to obtain, as almost each steel maker has some methods which he has perfected after many and costly trials, and he is naturally unwilling that others should know all his plans; this feeling in the steel trade in England has (since the visit of the Board) prevented the Iron and Steel Institute from holding its annual meeting in Sheffield—the great centre of the British steel industry. Although the Ordnance Board had exceptional facilities for visiting steel works, as the representatives of probably important purchasers, they experienced something of this unwillingness to give information, as Krupp's firm declined to allow the Board to visit their works, plainly writing that a simple walk through the Essen shops would not be all that the American Officers would require, but they would desire that the system of construction should be made clear to them—"an amount of information scarcely to be expected." Again, at Sheffield, the Board found steel manufacturers, giving much attention to the forging of steel ingots, but they were reticent on the subject; and apparently at other works information on these points was withheld, while details of mechanical structures, &c., were freely given. The writer remembers during a recent visit to the works of a large Sheffield steel firm, asking some question about a certain process in steel making, and receiving in reply a most polite account of many things, but there was only the slightest possible reference to what was asked: it vividly recalled the old game of cross questions and crooked answers.

The Gun Foundry Board show the possession of a wide and comprehensive grasp of the subject, and as most of the chief steel and ordnance works in Europe were visited at about the same time, they had good opportunities of comparing their relative merits, and there are probably very few Officers in our service who will not learn something of the rapid development of steel and of modern Artillery in Europe from the pages of this book.

The introduction is occupied with various official letters, &c., concerning the need of the United States for modern guns, and the appointment of the Gun Foundry Board, who soon found on enquiry among the leading steel makers of their country that none could produce the large masses of steel necessary for guns, simply because it was a new field to all of them, and the special plant did not exist. Several were willing to undertake the work if some assurance would be given by their Government to enable them to meet the outlay necessary for large hammers, cranes, and plant generally, but none had practical experience, hence the Board paid a visit to Europe, and

accumulated the valuable information contained in the book under consideration. It is not a little remarkable that although the annual production of steel in the United States is not very far short of the total produced by all the continental nations of Europe, that at present she is deficient in the making of gun steel, which demands a special plant for the large masses which have to be forged; the heaviest hammer in the United States is one of 17 tons, while France possesses one of 100 tons, and Krupp is making another of 150 tons.

The Board report, on their visit to England, that vast sums had been expended some years ago in the production of Armstrong guns in a lavish manner, and the Elswick firm purchased from the Government a valuable plant for the production of guns at a merely nominal price. But, on the other hand, it is distinctly recognized that much aid has been furnished by Elswick as an independent assistant in the production of ordnance, and the enterprise and ability in its management has been of much assistance to the country.

Previous to the visit of the Board to Europe the idea prevailed in the Ordnance bureau of the United States that Woolwich hindered the improvement of ordnance in England; but this is not the recorded opinion of the American Officers after their tour; on the other hand, the magnitude of the Royal Gun Factories, and the state of their preparation for the change in the system of manufacture are described with approval. The chief features mentioned in the Royal Arsenal are the manufacture of steel in Price's retort furnace, which is carefully described with diagrams: the present method of trepanning or core-cutting instead of boring; the system of testing steel, and the immense radial crane. Attention was also called to the boilers which are all of the same size, and the arrangement of 24 assembled in one place was remarked as convenient: it was noted that shrinking and tempering are not done in the same place, and thus separate cranes are employed: but the huge area swept over by the large crane might have suggested the thought that when finished it will be employed for both purposes; the notice concludes by remarking on the transition state of the Royal Gun Factory, which prevents it from serving as a good type to copy in designing fresh works.

Of the private works in England, Elswick naturally claimed attention. The Board considered the workshops to be badly placed on a narrow hillside, but rail and water communications are excellent. The addition of steel works capable of casting 100-ton ingots was noted, as well as the fine machine tools, and also that which must strike any visitor to these splendid works, viz., the abundance and excellence of the hydraulic machinery; the Board state that, in their opinion, no foundry or gun factory can be considered efficiently equipped without a plentiful supply of hydraulic power. Several hydraulic machines for hauling and lifting are described, and a drawing is given of the 160-ton crane made at these works for the Italians at Spezzia. It was noticed that the shrinking and tempering pits are side by side, so that a single crane is economically employed.

The principal makers who furnish steel for ordnance were visited; at Sheffield the Board found that crucible steel of high quality is

produced by Firth & Son. Great care is taken to cut out small cracks from the ingot before forging, and various machines and tools were considered excellent. Steel, on the open-hearth plan, is largely produced at Vicker's, where, besides steel for ordnance, large masses for propeller shafts of the best quality are produced.

The manufacture of armour at the two large works where it is made in England (the Atlas works and Cammell's) is very fully described with many diagrams, and the Royal Engineer Experiments at Shoeburyness in August and September, 1883, when compound armour backed by granite gave such good results, are recorded.

The Board reserved its highest praise for Whitworth's works, which were visited after all others in England and abroad had been seen. They consider the plant to be the finest in the world for the manufacture of gun steel, and they commend both the arrangements of the factory and the steel produced. The hydraulic fluid-steel pressing machine is carefully described with diagrams, and the system of forging steel by hydraulic pressure is considered to be better than the use of the hammer. The recent performance of the Whitworth 9-inch gun for the Brazilians, lately described in these pages, is alluded to with sketches.

The Bessemer works and those of Bolckow, Vaughan & Co., where the basic process is carried out on inferior ores, were visited, but as the Board did not consider the steels produced by these processes at present available for gun making, the American Officers did not devote much attention to them, though they are widely useful for various industrial purposes.

In France, the Board found that before 1870, the direction of the manufacture of ordnance was entrusted to the Artillery, and private aid was discouraged, but the experience of war proved this to be a bad plan, and on the return of peace this system was changed, and private companies have received such assistance from Government that they have been induced to spend considerable sums on the plant required for casting large masses of steel for making heavy guns. A list of the companies capable of producing the largest steel ingots, of others having the plant of a gun factory, and of others again able to produce armour plates is very considerable, and there cannot be a doubt that France has immense resources.

There are three Government factories for the smaller natures of ordnance for the Army, the steel being supplied from private works, a fourth factory produces gun carriages, limbers, &c. At Ruelle is a fine factory for heavy coast and naval guns, with tools capable of handling guns of 160 tons: the plant took five years to set up, dating from the giving of the order: but this long period was due to the fact that no tools of such size and capacity had ever been made before. A drawing is given of a 100-ton hydraulic crane, and mention is made of a 120-ton railway truck for the transport of ordnance by land: it is very long and is carried on two bogies, each of which rests on twelve wheels, so that the great weight is well distributed on the rails; a similar truck is in use in Turin. Krupp also employs a gigantic wagon for carrying very heavy ordnance.

The French Government, intent upon progress, have lately insisted on more rigorous tests for steel, which their own makers at first declined, but afterwards agreed to comply with: in the meantime, however, a large contract was given to a foreign firm.

Of all the French works the most important is that of Le Creusôt, with its 100-ton hammer and 160-ton steel crane, and arrangements for casting the heaviest steel ingots; here are produced the celebrated steel armour plates as well as gun steel, and a great variety of work for industrial purposes; it is advantageously situated in the centre of the country, and by rail and water-ways is in communication with the Atlantic and Mediterranean, and, in fact, with all parts of France. The magnitude of these works can be estimated from the fact that 15,000 persons are employed by the Company, and 30 pages and 15 large diagrams of the book are devoted to this great industrial centre.

Of the other works, St. Chamond, with its 80-ton hammer, and capacity for casting 100-ton ingots, and also its excellent machinery called for remark; and at Terre Noire, the special steel produced by the Siemen's-Martin process for making castings almost free from blow holes is described; the Board noticed that at the latter works the casting pit is between two large furnaces, and they consider this a bad arrangement, because the intense heat injures the workmen.

The refusal of permission to visit Krupp's works prevented the Board from gaining personal information about the manufacture of German ordnance, as the huge Essen works alone produce all that is required. This establishment is situated in the midst of good coal mines, near the Rhine, and surrounded by railways; its magnitude and importance are well known, and some 20,000 persons are employed.

Krupp has employed the crucible process for gun steel making, and often hundreds of men poured the contents of small crucibles into one large ingot; the Board think it unlikely that this plan is still continued, as the open-hearth system is, in their opinion, far more convenient in working, and if the old plan is still carried on they considered that the economy of making use of the existing large crucible plant could be the only reason for its continuance. The information about Krupp's works is necessarily somewhat scanty; two members of the Board had previously visited them.

Russia has dealt largely with Krupp, but now manufactures for herself. The smaller natures of guns are made in the Gun Factory at St. Petersburg, and it was observed that most of the tools were of English manufacture or Russian duplicates of the same. The Aboukhoff works not only produce steel on a large scale, but also manufacture ordnance of all calibres for the Army and Navy; these important works only began business in March, 1879, but they have rapidly increased, and some 1200 workmen are employed; ingots of 40 to 50 tons can be cast by the crucible process, which is there preferred, and the steel can be forged by a hammer of 50 tons, which however was only put up at great expense, as it was difficult to obtain good foundations in the alluvial basin of the Neva. Although so newly erected these steel works are in a transition state, preparations are being made

for a new plant, and Sir J. Whitworth's process of liquid compression has lately been introduced. The Russian iron ore is of first-rate quality, and good steel is produced, though the price is somewhat high.

In the United States, the Midvale Steel Company can make steel for 6-inch guns, and at the Navy Yard, Washington, guns up to 10-inch calibre can be made if the heavier forgings are supplied from abroad: the Board frankly confess that at the present time the United States is destitute of a source from which such an armament as the age demands can be supplied. The largest steel works in the States are the Cambrian, employing some 8,200 men, situated in a district rich in coal and iron, with good rail and water communications.

The Board also considered the present condition of ordnance in the chief countries of Europe.

In England, the military and naval services are changing their armaments, and adopting steel guns; the axial vent, enlarged powder chamber, shallow polygrooved rifling, Vavasseur driving-bands, the interrupted screw breech-loading gear, and de Bange obturation, are all described, and finally the progress in wire gun construction is given in considerable detail; some drawings, evidently copies from Royal Gun Factories designs, are attributed to Elswick. No mention is made of the 110-ton now being made by that firm for our Government.

France possesses a large number of cast-iron guns hooped with steel, and others with half tubes of steel, a body of cast-iron, and outer hoops of steel, some of the latter being of puddled-steel coiled and welded: but great progress is being made, and as far as the Navy is concerned, cast-iron has been definitely abandoned. The heaviest French gun appears to be that of 75 tons, although for experimental purposes one was made chiefly of cast-iron of about equal strength, which weighs 100 tons. The French ordnance generally have a very large number of narrow hoops, but in the heaviest guns a steel jacket is also added to assist in giving longitudinal strength. A good description is given of the de Bange obturation and interrupted screw, and finally progress in wire construction is given, with an account of Schultz's gun, made in 1882, which failed at the first round, owing to the unequal tension of the longitudinal bars.

The German guns are made on Krupp's models of an inner steel tube and outer hoops, but in the larger ordnance there is a steel jacket as well; guns of 120 tons weight are now being made at Essen for Italy. The Board considered that the German Government acts unwisely in relying entirely on one maker, who charges a high price, and may be difficult to control under emergencies.

The heaviest Russian guns are of 40 tons, but experiments are being made with a longer one of the same calibre of 50 tons; the siege ordnance are chiefly of bronze, but they will be replaced by steel ones; the insertion of a thin steel lining in a gun with a worn bore was witnessed, and mention is made of the two 9-inch mortars in three parts (for convenience in transport) used on the Danube in the late war; the inner tube was forced into the other parts (on the field) by an hydraulic jack. An important accident to an 11-inch gun is recorded,

when a bursting charge of 40 lbs. of guncotton in a shell exploded in the bore; the breech of the gun was blown off, and the trunnion ring was broken, while the diameter of the chamber was enlarged one inch, thus showing the admirable quality of the metal. The majority of Russian guns have Krupp's side wedge, but a few are provided with the interrupted screw breech-loading arrangements; it is remarked that the experimental practice grounds of the Russian Army and Navy at Ochta are side by side, so that each can witness the progress of the other.

United States designs are given for 6-inch and 8-inch guns of new construction; these correspond with modern English guns, except that the outer hoops are smaller and more numerous than ours; designs are also given for wire guns, but practical difficulties are apprehended.

Carriages for guns are incidentally mentioned in various parts of the book, the English Vavasseur mounting for the Royal Navy is much praised for simplicity, working power, and small space occupied; no less than seven large sketches are given of various natures. The Russian elastic field carriages provided with rubber buffers are described, but no mention is made of those with hydraulic buffers made experimentally in England. The 12-inch 40-ton Naval Russian guns are mounted on carriages on the principle of Colonel Moncrieff, and they are commended as compact and strong.

The book concludes with estimates and recommendations: the Board considered that steel should be made by private firms, and that there should be two gun factories in America, one for the Army and the other for the Navy. France is considered to have made better arrangements than other nations have done between the Government and the steel makers; aud they consider that Whitworth's establishment is the best type of factory to copy.

The English guns are declared to be the cheapest, while those of Krupp are the dearest.

It will be seen that the book deals with a great range of subjects, many of which have necessarily not been alluded to in this somewhat lengthy notice; the American Officers have certainly executed their work with care and ability, and Lieutenant Jaques has rendered good service by his full description of their labours.

NOTES:

BY VARIOUS HANDS.

THE

ROYAL ARTILLERY STEEPLECHASES, 1885,

WILL TAKE PLACE IN THE

PLUMSTEAD MARSHES,

On FRIDAY, APRIL 10th,

(UNDER GRAND NATIONAL HUNT RULES).

Stewards.

COLONEL T. E. BYRNE, R.A.

COLONEL A. H. W. WILLIAMS, R.H.A.

COLONEL A. H. KING, R.A.

Committee of Management.

COLONEL A. H. W. WILLIAMS, R.H.A.

LIEUT.-COL. HALE WORTHAM, R.A.

MAJOR T. B. TYLER, R.H.A.

CAPT. THE *HON.* W. C. ROWLEY, R.H.A.

Starter ... ... COL. B. F. SCHREIBER, C.B., R.A.

Judge and Clerk of the Scales... ... MAJOR T. B. TYLER, R.H.A.

Clerk of the Course aud Stakeholder ... LT.-COL. S. H. TOOGOOD, (*late* R.A.)

PROGRAMME.

Races 1 and 2 are open to hunters the property of, and ridden by, officers on full or half-pay of the Royal Artillery. Horses entered for these two races cannot be entered for races 3 and 4.

1.—**The R.A. Gold Cup** value **70** sovs. added to a sweepstakes of **5** sovs. each, **2** sovs. forfeit, with **50** sovs. added. 4 years old to carry 10st. 7 lb.; 5 years old 11st. 12lb.; 6 years and aged, 12st. 7lb. A winner of 30 sovs. to carry 5lb. extra; 50 sovs. 10lb. extra; twice 50 or 100 sovs. 14lb. extra; 150 sovs. 21lb. extra. If 5 starters, the second to receive 20 sovs from the fund. About 3 miles.

2.—**The Ubique Plate** of **50** sovs. 11st. 7lb. each. A winner of 30 sovs. to carry 5lb. extra; 50 sovs. 10lb. extra; 80 sovs. 14lb. extra; 100 sovs. 21lb. extra; 150 sovs. 28lb. extra. If 5 starters, the second to receive 10 sovs. from the fund. Entrance 2 sovs. About $2\frac{1}{2}$ miles.

Races 3 and 4 are confined to hunters the property of, and ridden by, officers on full or half-pay of the Royal Artillery, which, in addition to being qualified as such by Grand National Hunt Rule 161, have been regularly hunted during the past season by their nominators with stag hounds, fox hounds, harriers, or drag hounds, and have been in their possession since 1st February, 1885.

Race 3 is open to officers who have served in the Royal Artillery.

3.—**The Welter Hunters' Stakes** of **2** sovs. each, **1** sov. forfeit, with **40** sovs. added. For hunters which have never won a race of any description. A winner after entry to carry 14 lb. extra; 13st. 7lb. each. About 2 miles.

4.—**The Light Weight Hunters' Stakes** of **2** sovs. each, **1** sov. forfeit, with **40** sovs. added. For hunters which have never won a race of any description. A winner after entry to carry 14 lb. extra; 11st. 7lb. each. About 2 miles.

Entries for these two races to be accompanied by a certificate, signed by the nominator, in the following form:—

" I certify that.................................has been bonâ fide and " unconditionally my property since 1st February, 1885, has been " regularly hunted by me during the past season, and ridden as a hunter, " and not for the purpose of qualifying for this entry."

Races 5 and 6 are open to hunters the property of, and ridden by, officers on full pay or half-pay of the Army or Navy, or officers of the Militia or Yeomanry.

5.—**The United Service Stakes** of **5** sovs. each, **2** sovs. forfeit, with **50** sovs. added. 4 years old to carry 10st. 7lb.; 5 years old 11st. 12lb.; 6 years

and aged 12st. 7lb. A winner of 30 sovs. to carry 5 lb. extra; 50 sovs. 10lb. extra; twice 50 sovs. or 100 sovs. 14 lb. extra; 150 sovs. 21 lb. extra. The second to save his stake. About 3 miles.

6.—**The Open Military Plate** of **50** sovs. 12st. each. The winner to be sold by auction for 150 sovs. If entered to be sold for 100 sovs., allowed 7lb.; if for 50 sovs., allowed 14 lb. Entrance 2 sovs. About $2\frac{1}{2}$ miles.

⁂ Entries to close to Lieut.-Col. Toogood, Kingsworthy, Winchester, on Wednesday, 25th March. In the Regimental Races each entry must be accompanied by a certificate, signed by the nominator, that the horse entered in his name is bonâ fide and unconditionally his sole property, or the joint property of himself and some other officer qualified to enter. In the latter case such partnership must be registered in accordance with Grand National Hunt Rules. A special certificate has been given for the Welter and Light Weight Hunters' Stakes.

CONDITIONS.

1. Six entries from six different owners to be made for each race, or the race will be considered void.

2.—Three horses, the property of different owners, to start for each race, or only half the added money will be given.

3. Entrances and forfeits to go the fund.

4. Owners not carrying the colors declared to be fined 2 sovs.

Any further information can be obtained on application.

S. H. TOOGOOD,
Lieut.-Col. (*late* R.A.),
Hon. Sec.

Kingsworthy,
Winchester,
10th January, 1885.

SKETCH OF DRILL AND EXERCISE

FOR

TWO BATTERIES OF HORSE ARTILLERY,

AND

TWO REGIMENTS OF CAVALRY.

BY

COLONEL W. J. WILLIAMS, R.H.A., C.B.

General Remarks.

1. For Brigade drill, the Batteries must parade the same number of guns; for the Regiments to have the same number of Squadrons is not necessary.

2. The marking of Artillery and Cavalry not being the same; and it being desirable to retain in Artillery the practice of dressing up to the horses' heads of the markers—for line and any line of columns, Artillery and Cavalry markers must be dressed fronting different ways, with their horses croups in line. In changes of position, the inner Regiment must send out markers as soon as the change is ordered, before the troops move; it would be better if Artillery placed their base clear of their inner flank in the new position, instead of marking for both flanks of the base Battery. The regulation for moving bases in Artillery wants amendment and extension: in the meanwhile, Officers must trust to their general knowledge of drill, move with a base towards their inner flank, and appoint an Officer to superintend the base.

3. Artillery must have battery scouts, and the sound "Scouts out." It is essential to the freedom of the Arm to reconnoitre ground for itself, and to guard against surprise, by its own trained scouts. Battery scouts should be out when the Artillery are advanced on a flank in brigade echelon; when changing position; in line with the rest, when the ground to the front is not clear, or the flank seems exposed; and always in advancing to attack, whether the front is covered or not, and whether the Commanding Officer has gone to the front or not.

4. As, at a trot, Cavalry are faster than Horse Artillery; and as Horse Artillery ought frequently to manœuvre at a gallop—Horse Artillery drilling with Cavalry should take every opportunity of galloping; care being taken not to gallop in quarter column, or in column of sub-divisions, and not to gallop a whole Battery too short a distance. The Artillery must move off at the pace ordered by the Brigadier; but it should be understood that they may gallop by order of their Commanding Officer, he taking care that his trumpeter does not sound.

5. In the gallop of Horse Artillery, the horses should be freely extended; the pace must be limited by the fastest pace of the slowest team, to preserve dressing: the pace can be steadied before any manœuvre, or a halt.

6. The drill of Horse Artillery and Cavalry brigaded together ought to be lively; and, to make it lively, the Brigadier should give almost all commands by word of mouth, sounding little more than "March" and "Halt." Commanding Officers, in expectation of an order, must watch the Brigadier, and keep as much towards him as they can without losing hold of their Regiments; with some practice, the Brigadier and Commanding Officers will know where to place themselves so as best to hear and be heard, and to have the brigade in hand. Only orders in drill terms should be sent by Orderly Officers; for instructions, Commanding Officers can be fallen out by word of command, or by order through the Orderly Officers; or, Commanding Officers, Battery Commanders and Squadron Leaders can be fallen out to the first part of the Officers call.

7. In attacking the enemy, all troops in front of the Brigadier pass out of his hand as soon as they begin to gallop, and each Commanding Officer in front of the Brigadier is independent of any superior; for drill and exercise, Horse Artillery and Cavalry remain under one command, and strictly carry out attacks designed by the Brigadier.

8. Attack should constantly be borne in mind, and cannot be too much studied, and should be practised at every Brigade drill. It is also necessary to practise Horse Artillery and Cavalry together in other manœuvres which are not strictly warlike; lest, when the time of battle comes, Commanding Officers be found wanting in facility of handling their commands, and the troops wanting in readiness for manœuvre, and in that cohesiveness and that reliance on superior authority which are the sure results of good drill.

9. Horse Artillery brigade drill is the equivalent of Cavalry regimental drill; Battery drill is driving drill, Squadron drill is for the men, Artillery brigade drill and Cavalry regimental drill are for the Officers. The importance of our Cavalry having the best regimental drill which can be devised is recognized, and due attention is paid to carrying out the drill in practice. The brigade drill of Horse Artillery is uncared for: yet, Horse Artillery, in its use with Cavalry,

is an Arm of opportunity; and the Horse Artillery may fail to take part in a combat, if there is anything left to be desired in the drill of their Officers.

Rendezvous Formation.

The best rendezvous formation is still line of columns; that is, line of regimental quarter columns with the usual intervals of $28\frac{1}{2}$ yards for Artillery, and 24 yards for Cavalry. Quarter column is the best formation for the Artillery; and for the Cavalry, it is the best in our drill. Double column is more apt for deployment to line of Squadron columns; but double column at full interval is not a rendezvous formation, and double column at close interval is artificial; and that it is necessary to rendezvous in the formation most apt for deployment to Squadron columns is not apparent. As a rendezvous formation, double column is merely a compromise between quarter column and squadron column of divisions at close interval.

Manœuvres from Line of Columns.

1. *Advancing.*—Although it is easier for Cavalry to dress by Artillery than for Artillery to dress by Cavalry, the right Cavalry Regiment should be named to direct.

2. *Retiring.*—The Cavalry wheeling fours about at the caution, and the Artillery not wheeling sub-divisions about until the "March," the Artillery lose distance: the lost distance should be recovered as soon as possible, and 19 yards more to the rear gained, so that sub-divisions may be wheeled about square on to the alignment, if the next order is "Halt." As the gain of 19 yards to the rear brings the Artillery base up to one horse's length from the serrefile line of the fourth squadron, the Artillery may dress their base on the brigade base. The interval gained by wheeling sub-divisions about is kept in expectation of the next order. When Artillery are with Cavalry, it is better to Front the line before halting it.

3. *Taking ground to the right.*—When the line of columns is moving to the right, if the next order is "Fours left," and the advance is continued until the Artillery have wheeled up square, the dressing continues to be by the regiment of direction; but if the order is "Halt," as the Artillery require 19 yards to wheel up, the line of columns should be dressed on the Artillery.

4. *Taking ground to the left.*—The best manœuvre for the Artillery is to wheel sub-divisions right about, and then to the right, keeping the distance of 19 yards to the rear, in expectation of the next order, but making up the lost interval.

5. *Changing front.*—The inner Regiment changes front in quarter column: outer Cavalry Regiments gain their new positions by

shouldering in fours wheeled to a flank; Artillery on the outer flank move square. These manœuvres are cramped, and unsuited to Horse Artillery and Cavalry.

6. *Changing position.*—In changing position forward, the Artillery, according to the distance, move in quarter column or column of batteries, and the Cavalry in quarter column, or in column of troops from their inner flank; quarter column being formed on reaching the new position, the Cavalry forming on their outer flank. In changing position back, the Artillery wheel sub-divisions right about, move either in quarter column or column of batteries towards the new position, close to quarter column before reaching it, pass to the rear, and wheel sub-divisions right about. The Cavalry, for a short distance, can move in quarter column, rear rank leading; but their proper manœuvre is to retire in column of troops from their inner flank, change direction towards the new position, pass it beyond where the outer flank of the Regiment will rest, change direction inwards, and form quarter column to the flank on the new alignment.

NOTE.—To retire in column of troops from quarter column is not a regulation manœuvre. In line of columns, the regimental interval will perhaps sufficiently exceed the frontage of a troop to let a troop pass between Regiments: if it is not so, the Regiment may wait to move off in succession; or, squadrons in succession from the front or the rear may retire by fours from their inner flank, and, as soon as they are clear, form troops—as may be deemed best drill.

7. *Changing position to line.*—To change position to line would not be in accord with the Cavalry idea of not manœuvring in line.

8. *Changing position to line of batteries and squadron columns.*

(*a*). Changing position to the right. The Artillery words of command are—Change position to the right to line of batteries and squadron columns—Change position to the right to line—Advance in column of batteries, by the right—March—Batteries half right—Forward—Batteries right—Forward, by the right—Halt—Dress. For the Cavalry, the best manœuvre is—Advance in column of troops from the right—March—Heads of squadrons, half right—Forward—Heads of squadrons right—Forward—Right squadron direct—Halt—Dress up.

(*b*.) Changing position half right. The Artillery advance in column of batteries, shoulder towards the new position, and form line on the left; the best manœuvre is—Column will advance by the right—March—Left shoulders—Forward—Open to column from the rear—On the move, form line on the left—By the right—Halt—Dress. It is easier to place one battery first, and then to form line on the outer flank; but forming line on the move is smarter, and shows the next regiment where its inner flank will be. The Cavalry advance in column of troops from the right, change direction half right, and form line of squadron columns to the front on the left; or, advancing in

column of troops from the right, change direction half left, and form line of squadron columns to the right.

(*c.*) Changing position left back. The Artillery retire in column of batteries, wheel batteries half left into oblique echelon, wheel batteries left into line, pass to the rear of the new position, and wheel subdivions right about. The Cavalry retire in column of troops from the right, wheel heads of squadrons half left, wheel heads of squadrons left, pass to the rear of the new position, and wheel troops left about.

(*d.*) Changing position half left back. The Artillery retire in quarter column, shoulder towards the new position, open to column from the present rear, form line on the right on the move, pass the alignment, and wheel sub-divisions right about. The Cavalry retire in column of troops from the right, change direction half right, form line of squadron columns to the left, pass the alignment, and wheel troops left about—that would be better than changing direction half left, and forming line of squadron columns to the rear on the right.

NOTE.—In these changes of position, it is supposed that the Cavalry advance or retire from their inner flank, prefer oblique echelon of squadron columns to oblique echelon of troops, and front squadron columns by wheeling troops about towards the dressing.

9. *Deployment into line.*—Unless the deployment is made on the Artillery, they must incline to gain three yards to the rear, as the advance of the Cavalry base is not enough to allow of Artillery wheeling up square. If the deployment is on the Artillery, the base battery must advance six horses' lengths.

10. *Deployment into line of batteries and squadron columns.*—There is no regulation for deploying from quarter column to line of squadron columns.

MANŒUVRES FROM LINE.

The Cavalry regulation for changes of front and position now seems old fashioned; and new manœuvres have not been defined. Having established the principle of not forming line in attack until the time for manœuvres is past, the Cavalry have set aside the consideration of line manœuvres.

MANŒUVRES FROM LINE OF BATTERIES AND SQUADRON COLUMNS.

1. *Changing front.*

(*a.*) Changing front to the right. The Artillery change front to the right; the Cavalry change position by oblique echelon of squadron columns. The outer Regiment may manœuvre Heads of squadrons half right—March—Forward—Line of squadron columns to the front—Right squadron direct—Heads of squadrons, half right—Forward—Line of squadron columns to the front—Right squadron direct—Halt—Dress up.

(*b.*) Changing front half right. The Artillery change front half right; the Cavalry change position by oblique echelon of squadron columns, or by shoulder of regiments.

(*c.*) Change front left back on the right of the Artillery. The Artillery change front left back on their right gun; the Cavalry change position left back. The outer regiment may manœuvre by forming line of squadron columns twice on the inner squadron column wheeled half inwards.

2. *Changing Position.*

(*a.*) Change position to the right. The Artillery change position by oblique echelon of batteries; or, if the distance is long, by the manœuvre,—Batteries half right—March—Forward—On the move form line—By the right—Batteries half right—Forward—On the move form line—By the right—Halt—Dress. The Cavalry change position by oblique echelon of squadron columns, or by forming line of squadron columns twice from oblique echelon.

(*b.*) Change position left back. The Artillery wheel sub-divisions right about, wheel batteries half left, form line on the move, again wheel batteries half left and form line on the move, pass to the rear of the new position, and wheel sub-divisions right about; the Cavalry manœuvre in the same way by squadron columns, but wheel troops left about.

NOTE.—Changing position by forming twice on the inner battery, or head of squadron column, wheeled half inwards is the quickest manœuvre, and keeps the regiment more in hand of the Commanding Officer. The manœuvre is not accurate in theory, because, if the angle of direction to the new position is not less than 45°, either an advance must be made before any wheel of batteries or heads of squadron columns, or they must wheel less than half inwards.

FORMATION OF ATTACK.

When the brigade is in line, or in line of batteries and squadron columns, if an advance is made in echelon of regiments from the right, at 200 yards distance, Artillery in line, and Cavalry in line of squadron columns, the brigade assumes what may be called the formation of attack: Artillery and Cavalry are in their normal places for attack.

REMARKS ON BRIGADE ECHELON OF LINES.

1. The brigade in formation of attack can change front and change position, the lines keeping their respective places.

2. Changes of position of the brigade in echelon are manœuvres too wide to be regarded as plain drill; much neat regimental drill is involved in leading the Lines as steadily as possible, that is, with as

little trouble as possible to men and horses. The Brigadier would direct his first Line, and order the other Commanders to conform their movements with his; the Commanders of the other Lines would immediately take up any decided change of direction, and keep their Line distance and interval; the Artillery and Cavalry would keep as much as possible to their formations of line and line of squadron columns. If it were advisable to cover the brigade changing position back, a squadron would be detached towards the enemy: such squadron would extend a troop far and wide: the galloping of the extended troop would unfit it to join in immediate attack.

3. Changes of front of the brigade in echelon are not warlike; but they are useful manœuvres, as being the widest in plain drill.

Manœuvres of Brigade Echelon of Lines.

1. *Change front to the right.*—The Artillery change front to the right; the Cavalry advance in column of troops from the right, form line of squadron columns to the right, and take up their new positions.

2. *Change front left back.*—The Artillery change front left back on their right gun; the Cavalry retire in column of troops from the right, form line of squadron columns to the left, pass their new positions, and wheel troops left about.

3. *Change front half right.*—The Artillery change front half right; the Cavalry advance in column of troops from the right, change direction half left, form line of squadron columns to the right, and advance to their new positions.

4. *Change front half left back.*—The Artillery change front half left back on their right gun; the Cavalry retire in column of troops from the right, change direction half right, form line of squadron columns to the left, pass their new position, and wheel troops left about.

5. *Change front to the left on the first Line of Cavalry.*—The first Line of Cavalry changes front to the left; the Artillery wheel by batteries to the left, form line on the right on the move, and advance to their new position; the second Line of Cavalry advances in column of troops from the right, forms line of squadron columns to the right, retires past its new position, and wheels troops left about.

6. *Change front to the left on the first Line of Cavalry, which will change front left back.*—The first Line of Cavalry changes front left back. The second Line of Cavalry retires in column of troops from the right, forms line of squadron columns to the left, retires past its new position, and wheels troops left about. The Artillery wheel by sub-divisions to the left, change direction to the left, form line to the right on the move before all the column has changed direction, and advance by the left to their new position—line must be formed to the right, when the head

of the column is near enough to wheel up with Line interval from the first Line of Cavalry: the sub-divisions which have changed direction wheel up and advance, and the rear sub-divisions wheel half right and gallop into line.

NOTE.—Changes of front on the Cavalry are limited by the rule that the Artillery must not be moved across the front of the Cavalry. In all the changes of position of Lines involved in these changes of front of the brigade in echelon, it is supposed that Artillery and Cavalry move off from their inner flank, manœuvre in the most direct way to be able to show line to the new front, and then advance or retire to their new positions; and that squadron columns front by wheeling troops about towards the inner flank.

REMARKS ON ATTACK.

1. The brigade can attack from any formation. The best formation is echelon of Lines; the Artillery in line leading, and the Cavalry in line of squadron columns.

2. In war, if the enemy and the ground cannot be plainly seen, there ought to be reconnaissance. Horse Artillery and Cavalry should attack without much preliminary: it would be best if the Brigadier riding out to the front with his trumpeter could see what to do, without more reconnaissance.

3. Before the attack, two points ought to be settled; where the Artillery are to go into action, and on which side of the guns the Cavalry are to pass to attack. Artillery should be opposed to Artillery, and Cavalry to Cavalry; for the opposition of Artillery to Cavalry, and Cavalry to guns, would induce an awkward combat, in which Cavalry should charge Artillery, or be taken in flank by Artillery fire in crossing the field to attack Cavalry, and victory should not be decided without wasteful loss to the victor. If the disposition of the Artillery of the enemy is not marked, or if his distribution of Artillery and Cavalry corresponds with ours, or if we elect to conform our distribution with his, we may attack at once. If the distribution of the enemy does not fit with ours, and we purpose to try to make him conform his with our distribution, we must wait, and give him the chance of beginning the attack; but there is great moral advantage in beginning the attack.

4. Our field days show a tendency to reduce to very little the part of Artillery in attack. In war, Infantry will wait for Artillery; but there is risk of Cavalry not waiting. That the Cavalry are to advance and attack is plain; what the Artillery are to do has never been plainly laid down; and there is risk of the Brigadier not letting what is plain wait upon what is not plain.

5. There is, in our manœuvring, an overcautiousness with Artillery, caused by the unwillingness of the majority of Officers to believe in a

mounted Arm of which they know nothing practically. This want of knowledge and want of faith have found expression in our umpire rules. At field days and sham fights, we are accustomed to begin with Horse and Field Artillery as if they were the guns of position in old-fashioned battle; and then to advance a battery perhaps, if there seem to be frontage for it, to the rear of the flank of a wide Infantry attack which at its outset masked our guns in their first position: the Artillery are kept far from the enemy, or in rear of some of our troops, and always conform their movement with the movement of other troops. The idea of Artillery attack, of advancing Artillery into action at close or moderately close range, with only a few troops to support them, is beginning, even by Artillery Officers, to be regarded as a thing too wildly imagined. There is danger of the Arm being paralysed by a rule. It would be better for us all to believe, and to seem to know, that, except under heavy fire of a good Artillery, a line of guns can without recklessness be advanced into action at close range or within 1000 yards; that a line of guns in action can very well defend its own front; and that it is absurd to propose to govern the use of an Arm in battle by the rule that it is not to be exposed to loss.

6. When they attack with Cavalry, Horse Artillery should gallop into close or moderately close action as fast as they can cover the ground: they can be steadied on nearing their position, as the line should be placed in action with quite the correct front.

7. It may happen, that, for their unlimbering and their action, the Artillery will have only the time they can gain on the Cavalry by a quicker advance, added to the time between when the Cavalry pass the guns in action and when the Cavalry mask them.

8. If there is not a fair view over the ground, the position for the Artillery should be reconnoitred. The Commanding Officer of Artillery can make the reconnaissance.

9. It is easier to place one battery in position first, and to form line on the leading battery in action; but the two batteries should be galloped in line, and brought into action with the correct front.

10. In war, we must try to place our Artillery so that it may be able to fire both upon the Artillery of the enemy and upon his Cavalry: at drill, unless the ground is at least a mile square, we must almost necessarily imagine the brigade and the enemy to be on parallel lines, and the centre of the brigade to be opposite to the centre of the enemy. The Artillery, then, being on the right, should come into action with their right a little forward; and that makes a good drill manœuvre. The line advancing takes a sweep outwards by batteries half right, wheels up into line, and advances by the left; the Commanding Officer then causes the line to shoulder by dressing up the right of his base, or wheels batteries quarter left and forms line.

11. The rule for the support of the Artillery in action is the same as the rule for the support of the fighting line in Infantry; our Cavalry must be nearer to our guns than our guns are to the enemy. This rule need not be strictly observed; for, if the enemy anticipates us, his Cavalry will attack our Cavalry, and not our guns.

12. If the first Line of Cavalry is not to attack straight to the front, at least one squadron should be attached to the Artillery.

13. Artillery in action, whether Cavalry are detailed for duty with them or not, should have a patrol of their own, one Officer and two men, well in advance and wide of the outer flank.

14. Our Cavalry are enjoined to make flank attacks; especially the second Line is to make a flank attack. To have reason to suppose that manœuvring to make a flank attack would be of advantage to us, we must also at least suppose that the drill of our troops is better than the drill of the enemy, and that our Commanders are more skilful and alert than his. Without these superiorities in a high degree, we should harass our troops, and prolong the affair, without improving our chance of success; and we should also incur the risk of being suddenly attacked by an enemy who manœuvred less.

15. The parallelism of Lines and the opposition of centre to centre are hard to keep; but they are definite things to aim at. When those conditions are abandoned, which of two Lines will take the other in flank must almost always be mere chance. There can rarely be a Line Commander, whose two-fold faculty of handling his command, and of calculating the changing conditions of direction and distance and pace, shall be any considerable factor in determining how two oblique Lines will meet in the Charge.

16. There would seem to be a difference, on account of sword-arm to bridle-arm advantage, between a flank attack on the right of the enemy and on his left. If that difference is of any importance, and if our Cavalry are to manœuvre to try to make flank attacks, we ought to attack with our Cavalry to the right of our guns, rather than to the left.

17. Direct attack in echelon of Lines trusts more to the virtue of the troops, and the power of their horses, than to skill of troops or leaders. The plan has the advantage of simplicity: every man knows exactly what is expected of him; and the directions of attack do not converge to a cross.

18. In direct attack, the Lines must take sufficient interval to allow of each being led by its centre. A Line should be led with its centre on the centre of the enemy; but a Line must not be put on the incline.

19. The simplest plan of attack for two regiments, when the Artillery are in action to the right front, is to attack in echelon of regiments from the right, at 200 yards distance and 50 yards interval.

20. The echelon of regiments may be modified by the left squadron of each, or of either, Line being placed in echelon. If the left squadron of the first Line is in echelon, the interval between Lines may be increased.

21. The left regiment may form a third Line by attacking in echelon of wings, with regimental interval between wings and 100 yards distance; or a wing of the left regiment may be held in reserve.

22. If the whole of the second Line is to manœuvre to make a flank attack, the flank of the first Line must be guarded by its left squadron in echelon. If a wing only of the second Line is to manœuvre to make a flank attack, the flank of the first Line should be guarded by its left squadron in echelon, and the other wing of the second Line should be held in reserve, as its immediate advance in echelon would tend too much to a cross.

23. It can hardly be of any advantage to send out a squadron, or two separate squadrons, wide to the flank at the beginning of the advance. To strike in so as to affect the issue of the battle of the Lines, such squadrons must be audaciously led, and wonderfully favoured by fortune. The enemy could afford to disregard them; he might guard the flank of his second Line by echelon, or hold one or two squadrons in reserve.

24. The second Line has no time to manœuvre to make a flank attack from its place in echelon; and no increased interval will give it time: to have time, it must be as far advanced as the first Line. The best manœuvre is Heads of squadrons half left—Forward—Form column of troops—right wheel into line; that manœuvre giving the Line Commander the option of returning to his original front at any moment until he forms column of troops.

25. The second Line must not be drilled to make a flank attack across the prolongation of the attack of the first Line: if the first Line is on the right, it must be imagined that the second Line meets the enemy to the left of the first Line. The second Line manœuvring to make a flank attack must manœuvre wide.

26. If the second Line has to oppose a flank attack, the best manœuvre is—Heads of squadrons half left, or right shoulders—Forward—Form squadrons—Line to the front; and to attack in echelon of squadrons, if there is not time to form line. To attack in echelon of squadrons is objectionable, on account of the greater difficulty of keeping the proper front and the squadron intervals; but it is necessary to have the manœuvre to fall back on.

Remarks on Retirement.

1. Troops ought to be exercised in attack at every brigade drill, and in retirement rarely, or perhaps never.

2. With two batteries and two regiments, it makes pretty drill to place a battery on each flank, and to retire by half brigades in succession, with always some guns in action; but that manœuvre violates first principles.

3. The principles of a good retirement would seem to be these. There must be no hurry: there should be as much readiness to attack with the whole brigade as is compatible with retirement: serious fighting should be avoided, unless the enemy really compromises a considerable part of his force: care should be taken not to dash the spirit of the troops, by leaving a Line late, and then withdrawing it in presence of an advancing Line of the enemy: the Artillery is the Arm to hold the enemy: the Artillery should be kept together: the Cavalry should conform their movement with the movement of the Artillery.

4. The Artillery should fire carefully. A Division of guns may be fallen out to fire one or two rounds at any too advanced party of the enemy; and the line need not halt. The Line should not come into action for slight cause.

5. The Artillery and Cavalry can retire in succession, or, as it may seem to be, alternately; the Artillery retiring first and taking up a position, but not necessarily coming into action, and the Cavalry then retiring and placing themselves in echelon of Lines in support of the Artillery. This manœuvre may be executed in any advisable way within the Arms; that is to say, the Artillery may retire by batteries in succession, and the Cavalry by Lines in succession or alternately, and the Cavalry need not always wait until the Artillery have reached their new position; but it is better to retire the whole of the Artillery together, and all the Cavalry together in their echelon of Lines. Attention should be paid to clearing the front of guns sent back.

6. Perhaps the best way to retire is in formation of attack wheeled about'; the Artillery, nearest to the enemy, having a squadron attached to them.

A FEW

REMARKS ON FORTIFICATION.

BY

LIEUTENANT C. E. CALLWELL, R.A.

UNLIKE tailoring, there is no fashion in Fortification. There is less give and take about it than in other branches of the art of war; its precepts are stiff and rigid as the profiles of its parapets and the outlines of its ditches. Broad rules and maxims serve as landmarks to guide the student of Tactics on his way; but these mastered he has to decide on many important matters of detail among a host of conflicting opinions, and not a little is left to his own judgment. Rules of Procedure and Army Act, compact and comprehensive though they are, yet leave much to the intelligence of administrators of military justice. The draughtsman, hampered by prismatic compass and scale, still finds a certain field for enterprise; his handiwork admits of investment with artistic merit—imagination can be brought into play. With Fortification it is otherwise.

There is an authoritative precision about a Text Book on Fortification that must be eminently gratifying to one who is competing with "sections (*c*) and (*d*)." Can the aspirant for advancement but commit to memory that startling array of dimensions and technical terms, and obtain some slight grasp of the reasons and conditions that are scattered about among them broadcast, his promotion is, as far as fortification is concerned, secure. The whole thing is down in the book and apparently admits of no dispute. He has merely to remember and not to think.

Whether the stereotyped form of profile laid down in Text Books is the best for Field Fortification is a question that admits of argument. It seems natural to have a ditch round a fortification, no matter what its construction or object. The usage of centuries sanctions the principle. In the strong places of mediæval history the moat ranked second in importance only to the battlement. No modern fortress would be complete without its ditch. But the essence of defensive works in the field is the acquisition of cover for the defenders and exposure for the attack. Now the ditch is always viewed as an important feature in Field Fortification; but the necessity for it, nay, even the desirability of having it at all is open to question. The guiding principle in the throwing up of temporary earthworks should be the excavation of a ditch, the earth from which is thrown to the front to form a parapet, *e.g.*, the ordinary shelter trench and siege trenches. The deeper and wider this trench be dug the more commanding will

be the parapet, and the better the cover. It may sometimes be advisable to procure some earth from a wide and shallow trench in front, but this should not be viewed in the light of an obstacle. To throw away the invaluable cover existing in the ditch by placing it outside the parapet as an obstacle, is simply to put obstacles to the attack before cover or the defence in the scale of importance; an obvious fallacy.

Direct fire can affect a parapet little beyond spoiling its appearance; can only injure the defenders by keeping them down under cover; and is not the means that an intelligent commander would employ to prepare the way for attack. It is enfilade fire that must work the charm, must search out the enemy in his shelters, and carry death and destruction behind the ramparts. No efforts should therefore be spared in the erection of head cover, and in heaping up an abundance of traverses. A great prejudice prevails against high traverses, a prejudice arising from the fact that in fortresses they discover the position of the guns. This objection is of no account in Field works where Artillery will be seldom employed, and here the sole fault of high traverses is the large space they necessarily occupy.

If we endeavour to picture to ourselves the assault of a field work, the *viciousness* of the ditch as an obstacle becomes manifest. The work may be assumed to be a pivot in some defensive system. The operation commences with a heavy convergent Artillery fire on the point of attack, lasting probably for several hours. The parapets are reduced to furrowed shapeless mounds; the blindages and splinter-proofs are shaken down; some of the magazines perhaps blown up; while the *moral* of the defenders, crouching under their quaking structures, and hidden away in nooks and corners, suffers terribly from the pitiless cannonade. Still, if the interior of the work be properly constructed, its defence will not be abandoned without a struggle. Bombardment having done its work, the assaulting columns advance in attack formation; while their comrades at the guns, gathering fresh energy as the decisive moment draws near, pour in projectile after projectile with ever increasing rapidity and precision. No man dare show his head on the parapet for a single moment; to do so were death. But as the assailants hasten eagerly forward, the prize apparently almost within their grasp, the Artillery of the defence and the outer reserves begin to play on them from behind the work, crossing their fire on the line of advance and mowing them down by hundreds. At every step difficulty and danger increase; but, in spite of gaps in the ranks, of disorder and exhaustion, the front line, constantly fed from the reserves, presses on till it masks the fire of the attacking guns, and the seemingly deserted work, suddenly springing into life, salutes with a torrent of bullets, the advancing throng. Victory depends on a successful rush. Amid noise and smoke, and in the tension of a rapid advance, formations disappear; Companies, even Battalions are intermingled; and the assailants arrive at the defences a disordered straggling crowd. The nearer the parapet, the more deadly becomes the hostile fire. Already there are signs of wavering and panic is setting in, when at last the leaders reach the ditch. In they rush helter skelter, careless of mines and obstacles, bent only on gaining shelter for an instant.

Those still exposed, exhausted and almost despairing, regain their courage, make a final effort, stagger to the counterscarp and scramble in. There is a moment to recover wind. The soldiers—their blood is up and they mean mischief—have time to jam in a cartridge, and breathe some familiar oath, the officers to regain their *sang froid*, to distribute themselves among the men, and utter a few hoarse words of encouragement. Then "We're four to one against them, lads, ——— them! Come along!" A wild cheer, a brief *mêlée*, and all is over.

Why, the ditch is a perfect godsend to the attack. Were it not for this kindly obstacle the assailants would arrive on the parapet a panting and leaderless mob, overwhelmed by a withering fire from the start up to the very finish, only to be received on the bayonets of their calmly awaiting antagonists. Of course you can place obstacles in a ditch; but trees may not be available for abattis and fraises, nor wire for entanglements, and these devices would be far better applied to the open ground when attacking troops are under fire. Mines fired at the moment that the onslaught reached the ditch would certainly work great havoc, but the difficulty of ensuring their explosion at the right instant, at once presents itself as an objection. If the ditch be efficiently flanked it makes all the difference, but both theory and practice are opposed to the complicated traces required for this end.

Tel-el-Kebir experiences point towards night attacks on earthworks. A cordon of fireworks of some kind that would ignite when trodden on would serve as a useful line of outposts in the dark.

It is singular that the elaborate profiles of text-book theory but seldom seem to mould the clay and loam of practice. Engineers are ever busy erecting field works in some outlandish place, but their creations bear little resemblance to what we find in the book. We have seen defences constructed in some of our Colonies, in which trace and profile alike were at variance with preconceived ideas. The works consisted for the most part of very small walled enclosures perforated with loopholes, and circular in shape. They were usually perched on giddy heights, and their position coupled with the transparent appearance due to these loopholes, called to mind the views on the Rhine. Some of them had two storeys, and for the service of the upper tier of loopholes the defenders were provided with a ledge to stand on, which Thomas Atkins, iron nerves notwithstanding, would have hesitated before using, with the chance of being "tipped" backwards on to the terreplein beneath. Elsewhere forts were copied in principle from the type of fortified village that studs the low-lying and cultivated portions of the country they were constructed in. High mud walls with rounded projections at corners to serve as bastions, the tops crowned with crenulations and loopholes, and the whole plastered over and finished off with mud in the manner peculiar to the Oriental mason.

Mealie bags saved Rorke's Drift, and afterwards helped to form parapets for the defenders of Potchefstroom, parapets that served as food later on for the garrison. A couple of corn sacks stuffed with long grass, such as abounds during certain seasons all over South Africa, are sufficient to stop a rifle bullet, and a few such carried on the wagons empty, would make a very fair epaulment for guns.

Turning from field defences to siege works, it is impossible not to

be struck with a certain want of progress apparent both in their construction and in their application. Gabions, and indeed all revetments, require a prodigious store of materials; are of a weight and bulk out of proportion to their staying power; and call for much manual labour. Stress is laid on durability, a somewhat overrated quality. Durability is considered one of the chief desiderata of a good gun carriage, yet both gun and carriage occasionally become obsolete before the lasting power of their materials can be tested by time. Parallels and approaches are but required for a few weeks. A very light class of gabion is a necessity for flying trenchwork, and one that need only hold together for an hour or two. Surely one could be devised with a framework of wire and coating of canvas, opening and shutting like an umbrella so as to be easily carried, that would in every way serve the end in view. It is strange that in these days of scientific discoveries the progress of a siege should be permitted to hinge on the efforts of a single man grubbing in the ground with a spade, protected by such a preposterously cumbrous apparatus as a sap roller. Mountain chains are pierced, our guardian "silver streak" is being undermined, but we hear of no mechanical appliance for sapping out the final approaches of a protracted siege. In discussing fortress warfare we are groping more or less in the dark; in studying its aspects we seem to be ever engaged with what is obsolete; we hear much of the past and little of the future. Elaborate fronts of the "Modern French" type with their contracted lines of defence, their involved system of protection, and their inapplicability to ordinary ground can offer no adequate resistance to a modern siege train. The machine gun, undoubtedly the most potent weapon for flank defences, has been but recently introduced for this purpose abroad, and has no place in our land defences.

Whitehead torpedos might be employed with no small effect in the defence of a wet ditch, shoots for their discharge being easily applied to flanks; and two or three of them would make short work of the bridges and dams of the beseiger. Ironclad boats of light draught, worked by steam, and with a gun in the bows, could be navigated in the ditches of a fortress like Antwerp, and could only be assailed with fish torpedos. The sudden appearance of gunboats round a corner would prove very disconcerting to the enemy striving to effect the passage of the obstacle.

It is only by alighting on stray papers in service magazines and periodicals that the outsider learns of the great fortresses springing up on the continent. Familiar names like Ehrenbreitstein and the Quadrilatrial find no mention in their pages; they treat of the intrenched camps costing millions, and capable of sheltering huge armies that are being spread over the face of the strategic arenas of Europe. While the book market is flooded with literature on Tactics and Military Law, there is a marked deficiency of edifying and readable matter on Fortification. What is written on the subject is dry, detailed, and "professional." If some authority on the matter would give us the benefit of his knowledge in terse language, sparing of detail, arranged in a handy and not too profusely illustrated volume, with an interest infused into its lessons by references to the experience of recent war, he would confer a boon on the general military reader, and fill a decided want.

DESCRIPTION

OF AN

EXPERIMENTAL HYDRAULIC FIELD CARRIAGE

FOR THE

12-POUNDER B.L. GUN.

BY

CAPTAIN W. J. CLARKE, R.A.

Among the many intricate problems, which have arisen in connection with the re-armament of our Horse Artillery and Field Batteries, one of the most difficult has been the provision of a carriage, at once strong enough to endure the greatly-increased strain on recoil with the new type B.L. guns, and light enough to preserve unimpaired the indispensable quality of mobility. The hydraulic carriage manufactured in the Royal Carriage Department is an attempt at a solution of this problem, and although at present only experimental, yet as it is altogether novel in design, the following description may interest many officers who have not had an opportunity of witnessing recent experiments with Field Artillery material:—

It is doubtful if any formula has yet been proposed which expresses with accuracy the destructive effect on a field gun carriage due to recoil; the conditions affecting the question are so various that, possibly, were such a formula determined it would be too complex for any practical utility. The energies of recoil may, however, perhaps be taken, in order to obtain an approximate estimate of the comparative destructive effects of different guns on their carriages. The total energies of recoil of the 9-pr. R.M.L., the 13-pr. R.M.L., and the 12-pr. B.L. are respectively 3·1, 5·8, and 9·8 foot-tons, and the strains on the carriages are probably in about the same proportion. The work thrown on the carriage is consequently very much more severe with the new type B.L. gun, and special measures become necessary to enable it to stand the increased strain, without making any addition to its weight.

In the latest design of hydraulic carriage the trunnions of the gun are carried in a link, which pivots about the axletree of the carriage. The breech of the gun is attached to the piston-rod of a hydraulic buffer, the cylinder of which is also pivoted to the axletree. On firing, the gun moves back in the carriage, causing the link carrying the trunnions to revolve about the axletree; the piston-rod is at the same time drawn out of the buffer, and the motion of recoil is thus gradually communicated to the carriage. By this means the jar, due to the recoil of the gun, is very much diminished, and the carriage can be

made very much lighter than would be possible, if it were rigidly constructed. The fact, that the hydraulic buffer transmits the strain of recoil very gradually to the carriage, has been proved conclusively by means of Indicator Diagrams, which register the actual pressures in the buffer at each instant of the recoil. The curves given by these diagrams show that the pressure in the buffer increases gradually from the commencement of the recoil, until the gun has moved back about $3\frac{1}{2}$ inches, and then gradually diminishes, as the carriage takes up the motion.

History.

A carriage on the hydraulic principle was tried at Shoeburyness in 1882 for the trunnionless 12-pr. B.L. gun, with satisfactory results. Two carriages, similar to the one of which a description is given, were tried at Okehampton during the summer of 1883, and proved decidedly successful. These three carriages have recently had some alterations made in their construction, of which the chief are the lengthening of the brackets of the trail, in order to reduce the jump, and the substitution of the disc for the differential brake. Thus improved they have been issued to 'B' Battery, 'A' Brigade, R.H.A., for an exhaustive trial, under the superintendence of the Committee of which Colonel A. H. Williams, R.H.A., is president.

Description.

The carriage (Plate I.) consists of two light steel brackets with angle frames. The axletree is a steel tube which passes through holes in the front of the brackets, and is connected to them, as usual, by tensile stays.

A cast-steel link pivots on the axletree between the brackets. This link is formed with two arms, in which the trunnions of the gun are secured by cap-squares in the usual manner.

The hydraulic buffer (Plate IV.) consists of a steel cylinder (*a*), closed at the front end by a steel cap (*c*) screwed on. The cap is connected by a bayonet joint with a steel link (*i*), which fits on the centre of the axletree of the carriage, and can turn freely about it. This link is bushed with phosphor-bronze. The connection of the cap with the link is made additionally secure by a small steel set-screw.

A piston (*f*) and piston-rod (*b*), made of wrought steel in one forging, work in the cylinder. A steel shackle (*h*) is screwed on the rear-end of the piston-rod and secured by a taper steel pin. This shackle is connected to the breech of the gun by a pin.

The cylinder is filled with two pints of oil through a filling-hole, which is closed by an iron screw plug. The interior of the cylinder is not truly cylindrical, but is rather larger in the centre, and tapers off gradually to each end, where it is the same size as the piston. Except at the ends, there is therefore a small amount of clearance between the piston and cylinder. There are six holes in the piston, in which are placed phosphor-bronze valves. To obviate, as far as possible, wear between the sliding surfaces, the piston has a ring of phosphor-bronze round it.

When the gun recoils, the piston is drawn out to the rear, the

cylinder remaining fixed to the axletree of the carriage. The valves (*g*) are closed during this movement, so that the fluid, which was in rear of the piston, has to pass to the front of it, as it moves back, through the small clearance between its rim and the cylinder. A considerable resistance is thus opposed to the motion of the piston and so to that of the gun, and the recoil is thus gradually transmitted to the carriage, through the buffer. The carriage then takes up the motion and moves back in the usual manner. As the link carrying the trunnions revolves, it comes in contact with two small spring buffers fixed on the carriage brackets. These force the gun to return to the firing position towards the conclusion of the recoil of the carriage or immediately after it. The valves (*g*) in the piston open, as the gun returns to the firing position, so that the buffer does not oppose any practical resistance to movement in this direction. To prevent any jar to the carriage as the gun comes forward, there is a projection formed on the lower part of the link carrying the trunnions, which presses against a pad of felt and steel fixed under the front of the carriage brackets. A small hydraulic cushion is formed for the same object in the buffer itself, by an iron stop (*e*) screwed into the cap of the cylinder, which enters a recess (*f*) in the head of the piston as it approaches the end of its stroke. During recoil, the liquid in the buffer is pressed with considerable force against its rear-end, and special means have therefore to be taken to prevent its escaping round the piston-rod. With this object, a stuffing-box is formed in the rear-end of the cylinder, into which is placed (1) a leather ring (*k*), of U section, (2) a metal ring (*l*), (3) three rings of white cotton rope saturated with tallow (*m*), (4) a metal plug or gland (*n*), which is screwed firmly down on the cotton packing. This gland is prevented from working loose in travelling by a spring catch (*d*) fixed on the outside of the buffer.

Elevating Gear.

A toothed quadrant of steel (*d*, Plate I.) is pivoted between the brackets of the carriage on the bolt (*e*) connecting the ends of the tensile stays. This quadrant is linked to the breech of the gun by the steel rod (*f*). It gears with a worm (*b*) on a spindle, held in bearings attached to the transom (*g*), and worked by the hand-wheel (*c*). On firing, the link (*f*) revolves about the point of its attachment to the quadrant, but the latter does not move. To lessen as much as possible any jar on the gear, a pad of felt and steel is placed between a nut on the worm-spindle and its upper bearing.

Wheels.

The wheels are generally similar to those for the 13-pr. R.M.L., and have grease-chambers with screw-plugs in the outer flange of the naves.

Brake.

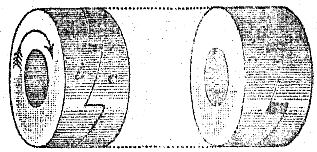
The recoil of the carriage, when unrestrained, has been found inconveniently long. Various descriptions of brakes have therefore been tried, in order to keep it under control. The present pattern (Plate III.), although consisting of a number of different parts, is really

extremely simple in principle, and has been found effective during the past summer at Shoeburyness and Okehampton. As the parts of this brake are concealed from view, and the construction is novel, a description in some detail is given. The brake is intended to skid the wheels during recoil, but not in any way to interfere with running-up. It is perfectly automatic, and only requires to be adjusted in coming into action and on limbering-up. It can also be used as an ordinary travelling brake when desired.

The principle of its construction is as follows:—

Suppose two plates of metal, placed together as shown in Fig. 1, having on their adjusting face a series of screw surfaces, as shown in Fig. 1, Plate III.; now if the outer plate (*b*) be turned in the contrary direction to the arrow it will cause the plate (*c*) to turn with it. If,

FIG. 1. FIG. 2.



however, *b* be turned in the direction of the arrow and the surfaces in contact are supposed smooth, and also there is some resistance to *c* turning, then *b* will turn without moving *c*, and the plates will separate slightly from each other; that is, the distance between the outer faces of the two plates (Fig. 2) will be slightly increased. If, now, the two plates be placed inside a drum, as shown in Fig. 4, Plate III., then, when the plate (*b*, Fig. 4, Plate III.) is turned in the direction of the arrow, the outer faces of both plates (*b*, *c*) will be jammed against the drum, and if the drum is fixed, it will be impossible to turn the outer plate more than a very small amount in this direction. When the plate *b* is turned in the contrary direction, then *b* and *c* both can revolve together inside the drum. If the drum itself be free to revolve, then the plates can be turned freely in either direction.

The actual construction of the brakes, which are applied to both wheels of the carriage, is shown in Plate III. It consists of a metal locking-plate (*b*) and a steel locking-plate (*c*), formed with screw surfaces, as above-described and shown in Fig. 1, Plate III. These plates are enclosed in a steel drum (*d*), made in two parts so as to fit round the plates, and held together by a metal ring (*l*), fixed to it by two screws.

It is necessary to ensure that, when the plate (*b*) is turned in the direction of the arrow, it shall always slide on the plate (*c*) without turning it. This will be the case, as long as the friction between the sliding-surfaces of the plates is less than the friction between the surface of the plate (*c*) and the drum. To effect this, a deep groove is formed in the plate (*c*), in this groove fit tightly two semi-circular friction-rings (*a*), having studs (*h*) on them, which enter slots in the drum. These pieces cannot turn independently of the drum, and may be practically considered as part of it. Their action is to increase very considerably the friction between the plate (*c*) and the drum, and so prevent any chance of *b* and *c* turning together inside the drum in the direction of the arrow.

The drum and plates are placed on the inner flange of the nave. A series of studs on the flange engage corresponding studs (*n*, Fig. 4) on the locking-plate (*b*), and cause the plate to turn with the wheel. A steel brake-band (*e*) passes round the drum, and is pivoted by a pin (*k*) to a brake bracket (*g*) fixed to the axletree. A differential screw (*f*), held in a bearing attached to the brake bracket, passes through the ends of the band. Two nuts on the screw engage the ends of the band and cause it to be tightened or slackened when the screw is turned.

A metal cross-handle (*r*) is fixed to the top of the screw (*f*), which is hollow, and contains a steel rod (*p*). On coming into action, this rod (*p*), which slides in a ball in the cross-handle (*r*), is drawn out of the screw, turned over into one of four notches in the cross-handle, and used as a lever to turn the screw. The brake-band is thus tightened on the drum. On recoil, the wheel tends to turn the plate (*b*) in the direction of the arrow, plates *b* and *c* are jammed against the drum, which is held by the brake-band; if this latter is sufficiently tight, the wheel will be completely skidded. On running up, the wheel turns the plate (*b*) in the contrary direction to the arrow, both plates turn together easily inside the drum, and no resistance is offered to the motion of the wheel.

On limbering up, the brake-band must be slackened; then, in travelling, the wheel, the two plates and the drum will all turn together. If it is at any time desired to use the brake in travelling, the band can be tightened sufficiently by using the cross-handle (*r*).

A grease-chamber (*m*) with a sliding metal cover is formed on the brake-band.

The axle seats are of steel plate, lightened out, and are supported on spiral springs. There are no axle boxes. A case shot and cartridge can be carried, when going into action, in leather cases on each side of the trail.

The handspike is straight and shod with copper, so that it may be used as a rammer, if necessary; it is secured by a strap, fastened by a spring catch on the outside of the bracket, and by a buckle on the inside.

Limber.

The limber (Plate II.) consists of a light steel frame secured to a hollow steel axletree similar to that of the carriage. The limber-hook is wrought iron, the splinter-bar is of steel plate, bent into the form of a square tube. The shafts, platform-board, footboard, and slat are of the usual form.

The limber carries two ammunition boxes made of corrugated steel plate, with steel partitions. These boxes open at the top; the lids are of steel plate, lined with wood, and are fastened by a strong lock. The boxes are secured on the limber in a similar manner to those of the 9-pr., but the pins fixing them to the platform-board are screwed.

Each box carries 18 projectiles, placed vertically round the sides, as in the 9-pr. 18 cartridges are carried in one metal cartouche in the off-box, in the near-box 16 cartridges are carried in a large metal cartouche, and two others in a small one. The lids of the cartouches are made watertight by india-rubber packing rings, and are secured, when closed, by spring catches. A small tin case is also carried

containing fuzes and small stores. The ammunition boxes are fitted with cranked guard-irons, and with handles front and rear.

A six-feet handspike is carried on the splinter-bar for use in case of emergency.

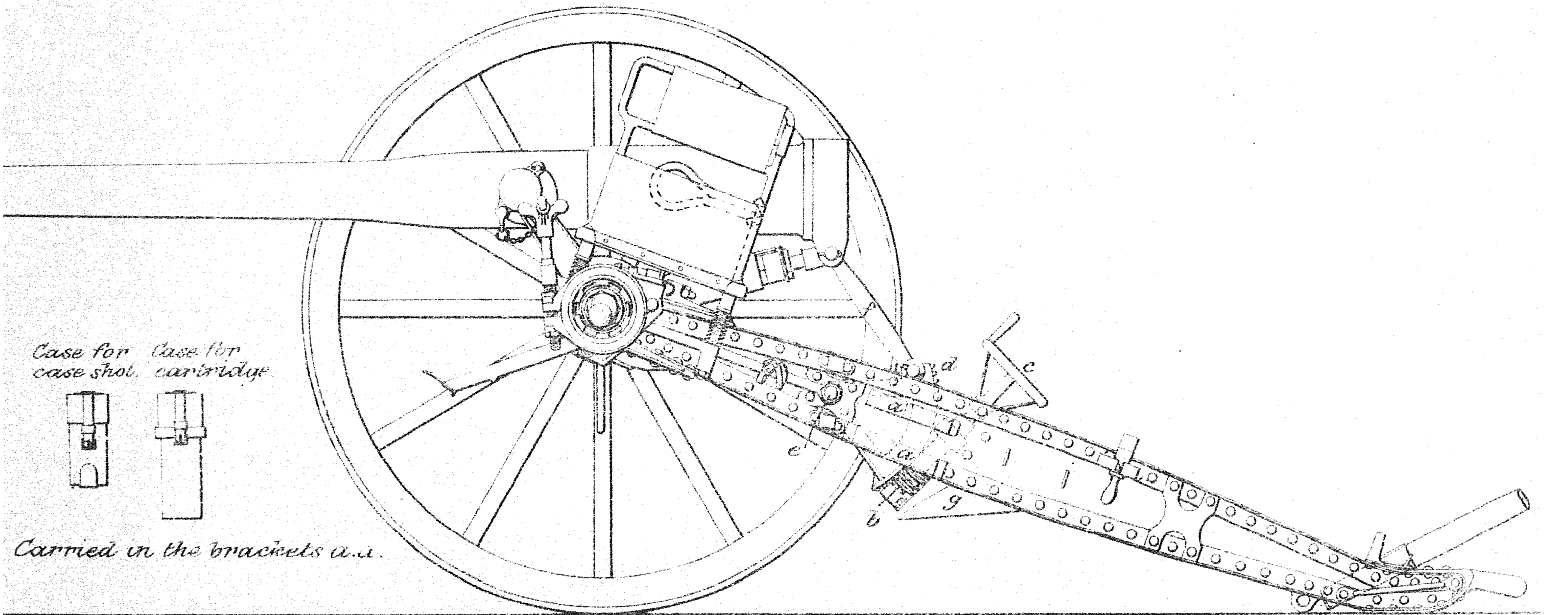
From the above description the carriage may appear complicated, but it is probably not more so than is absolutely necessary to enable it to stand the strain on firing a modern field gun, and at the same time to keep the weight within practical limits. The experience gained with this equipment will probably enable considerable further improvement to be effected in future manufacture. A carriage is at present in course of construction in the Royal Carriage Department, in which, by the employment of twin buffers, the line of resistance is made to coincide with the axis of the piece at all angles of elevation. In this arrangement, the pull of the buffer will always oppose a direct resistance to the motion of recoil of the gun, and thus all tendency to cause a twisting strain on the carriage will be obviated. The hydraulic buffer, which is now for the first time applied to the service of Field Artillery, has been for many years in use both for Garrison and Naval carriages, and has always proved perfectly satisfactory. It demands but little care or attention, hardly ever is known to get out of order, and is perfectly automatic in its action, requiring no adjustment whatever. It has been found able to stand a considerable amount of rough usage in boat carriages, and it may be hoped with some confidence that it will be found a most useful aid in increasing the efficiency of our Field Artillery.

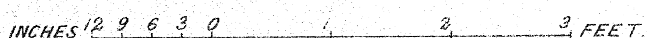
The accompanying table gives the most important weights, dimensions, &c., of the carriages described above. For convenience of reference and comparison, the corresponding weight, &c., of the 9-pr. and 13-pr. carriages have been added.

	12-PR.	13-PR.	9-PR.
Weight of gun	6 cwt.	8 cwt.	6 cwt.
〃 projectile	12 lbs.	13 lbs. 4 ozs.	9 lbs. 1 oz.
〃 charge	4 lbs.	3 lbs. 2 ozs.	1 lb. 12 ozs.
Muzzle velocity of projectile	1800 f.s.	1595 f.s.	1390 f.s.
〃 energy	271 f.t.	221 f.t.	121 f.t.
Energy of recoil	9·8 f.t.	5·78 f.t.	3·08 f.t.
	cwt. qrs. lbs.	cwt. qrs. lbs.	cwt. qrs. lbs.
Weight of carriage without wheels	6 3 15	9 0 6	8 0 26
〃 wheel	2 0 8	2 0 11	2 1 2
〃 limber, empty, with boxes and wheels	9 1 6	11 2 0	11 1 23
〃 ammunition boxes, empty ...	0 3 20	1 1 16	0 3 21
〃 〃 with metal cartouche	0 3 25		
Total weight behind team, 2 gunners on limber	39 3 0	42 2 2	39 1 0
Total length of carriage and limber with gun	24 ft. 6 ins.	22 ft. 8½ ins.	22 ft. 4½ ins.
Length required to turn	32 ft. 2 ins.	26 ft. 8 ins.	32 ft. 3 ins.
Height to axis of trunnions	3 ft. 6 ins.	3 ft. 6 ins.	3 ft. 6 ins.
Angle of trail	21°	30°	22°
Maximum elevation	16°	16°	21½°
〃 depression	5°	5°	4°
	cwt. qrs. lbs.		
Pressure on limber-hook	1 0 6	—	—
		cwt. qrs. lbs.	cwt. qrs. lbs.
〃 of trail on ground	1 0 6	1 0 18	2 0 0

CARRIAGE, FIELD, HYDRAULIC, LINK PLAN, B.L. 12 P^R.

(LENGTHENED TRAIL.)

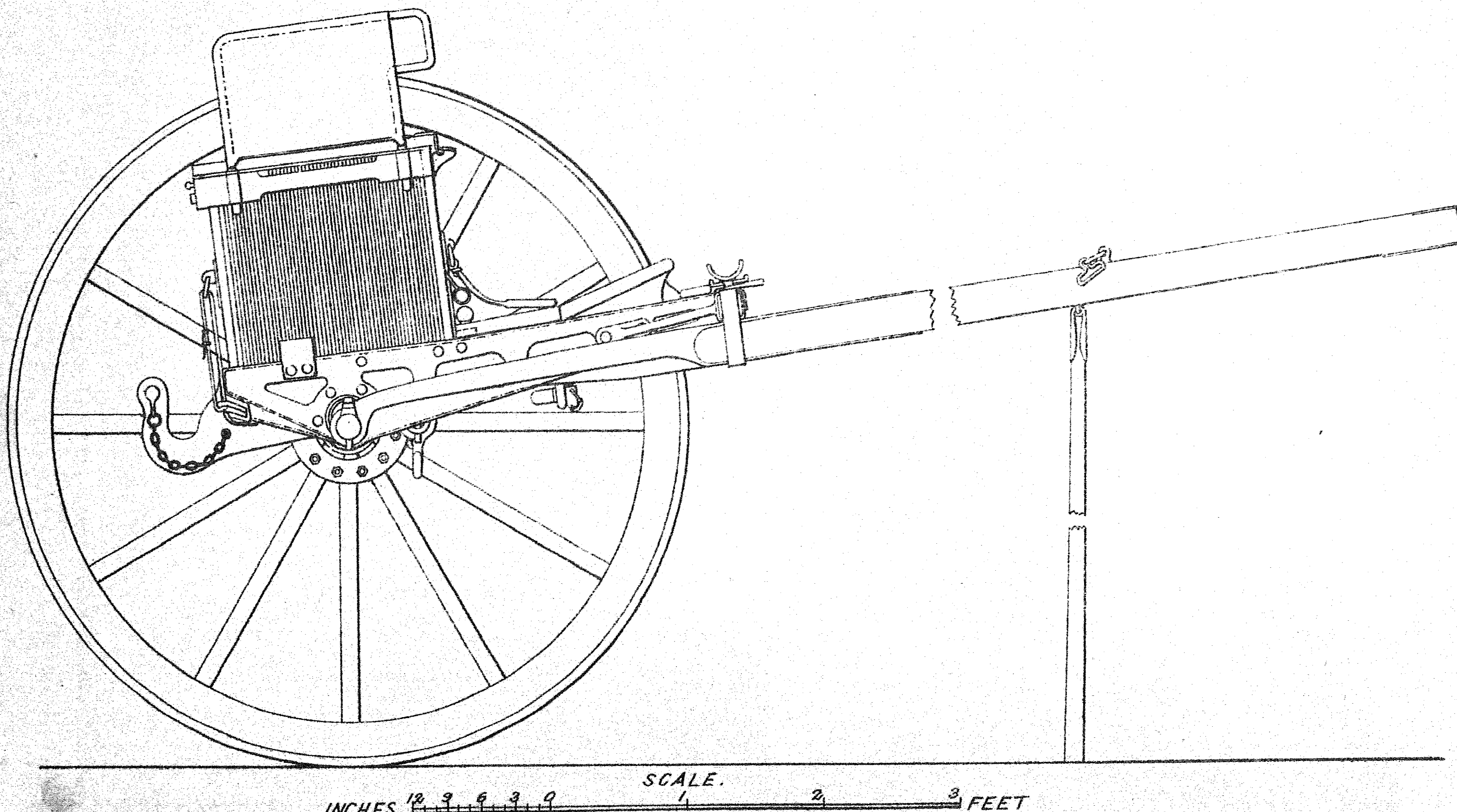




SCALE.

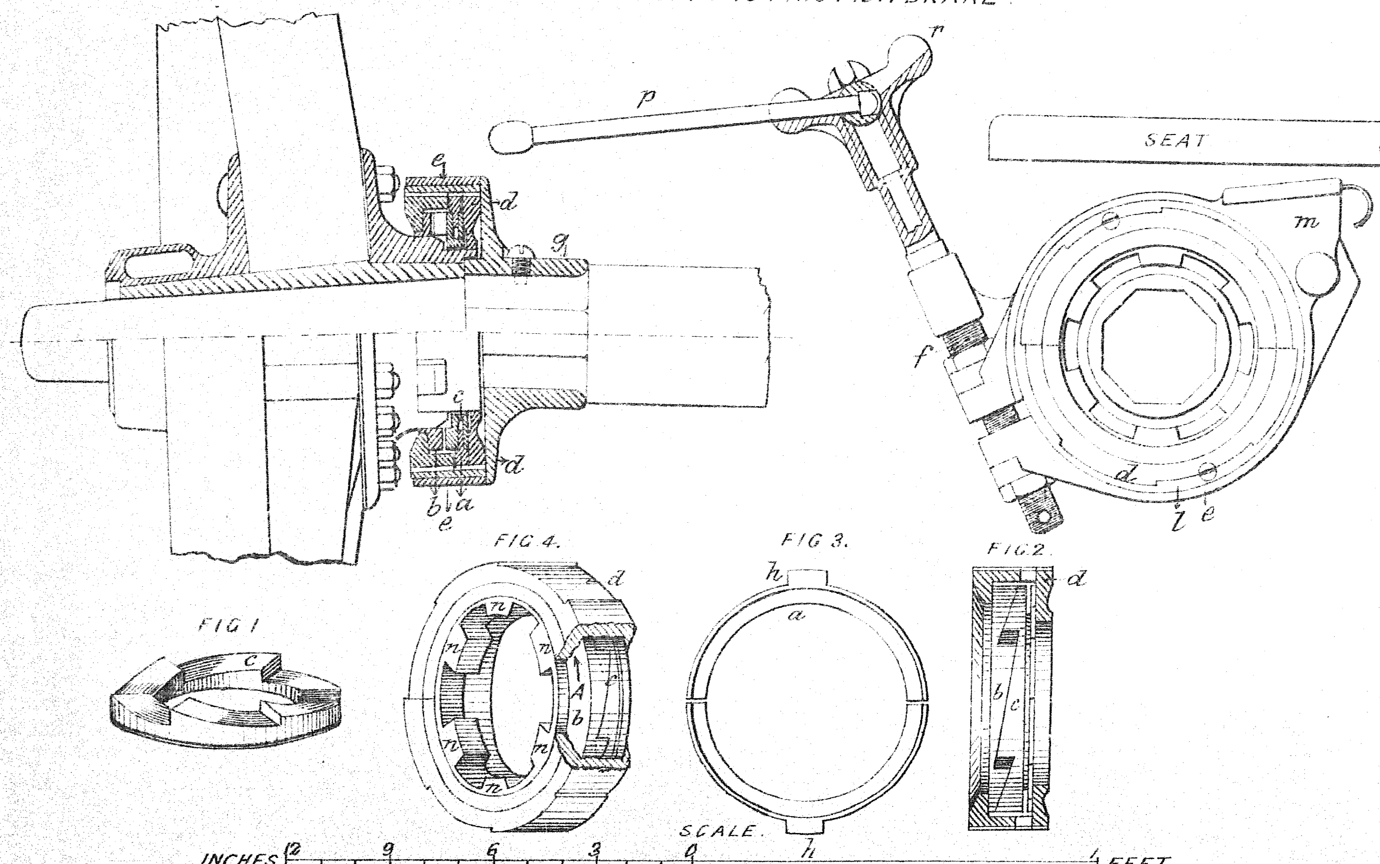
LIMBER, RIGID, B.L. 12 P^{R}.

(WITH STEEL BOXES.)



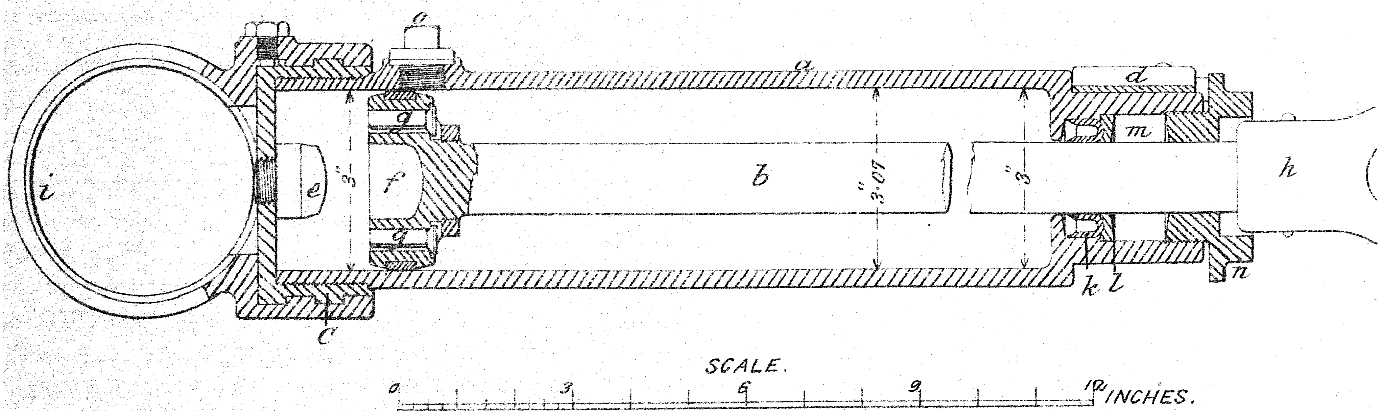
CARRIAGE, FIELD, HYDRAULIC, B, L, 12 P^R.

AUTOMATIC FRICTION BRAKE.



CARRIAGE, FIELD, HYDRAULIC, B, L, 12 P^R.

HYDRAULIC BUFFER.



BATTLE FIELDS

IN THE

LE MANS CAMPAIGN.

BY

CAPTAIN R. F. JOHNSON, R.A.

No. 9.

LE CHÊNE AND LES COHERNIÈRES.

10th and 11th January, 1871.

To visit the ground on which the German right column fought on the 10th and 11th January, 1871, take train to Connerré Junction. On leaving the station turn to the right and cross the rails by the road leading north-west. At the top of the hill 700 yards from the level crossing the road turns left (W.), and two tracks branch off into the heather; follow the right hand one to a point about 100 yards distant, whence the junction station and the valley of the Huisne can be clearly seen.

As the country is very wooded and no long view can be obtained, a summary of the fighting is given before the ground is described, but it may be as well to explain that the ridge you are on is a low flat-topped one running south-west and north-east; its north-eastern and south-eastern slopes, especially the former, are of considerable steepness, but the remainder are very gentle; its north-eastern half is covered with woods. The farm of Le Chêne lies on its western side, the Chateau Couléon in the middle of the north-western side, and the village of Beillé (500 inhabitants) at its foot at the eastern corner. Le Chêne is 600 yards behind you when facing the station, Couléon Chateau, 1100 yards in your left rear, just below the crest of the plateau, and Beillé 2800 yards on your left, due east.

Connerré, a small town (2200 inhabitants) lies amidst the poplars in the mouth of the Dué Valley, which joins that of the Huisne at a point south of your position. It was occupied early on the 10th of January by the detachment of the German right column, which the day before had fought further up the Dué Valley at Thorigné, whose church spire

is visible on a clear day. This detachment consisted of 3 battalions, 12 squadrons, and 12 guns.

The main column of the Germans, 10 battalions, 4 squadrons, and 24 guns, with a pioneer company, had reached Duneau, the village lying high up on the opposite bank of the Huisne Valley on your left front (S.E.). Another division more in rear had sent 3 battalions, 2 squadrons, and 6 guns to the villages of St. Hilaire and Tuffé, $3\frac{1}{4}$ miles away on your left, and early on the 10th had crossed the river at Sceaux 5 miles up the valley, and was marching towards Beillé with an advanced guard of 1 battalion, a company of pioneers, 1 squadron and 6 guns, and a main body of $5\frac{3}{4}$ battalions, another company of pioneers and 24 guns. As the St. Hilaire and Tuffé detachment had been sent northward to Bonnétable 8 miles off, the column was flanked on its right by 6 squadrons supported by 6 guns.

The French on their side had on the ridge where you stand a Division of 17 battalions, with outposts in the station and farms in the Huisne Valley, and resting their right on the farm of Les Cohernières, (pronounced Quonnières) which is nearly 2200 yards on your right across a side valley. Seven miles down the valley towards Le Mans another Division of 12 battalions was echeloned in rear of Pont de Gesnes, and yet another of 21 battalions lay on the Bonnétable—Le Mans high road 8 miles N.W. All the Divisions had from 12 to 18 guns and some mitrailleuses.

It was a dull dark day and snow was falling on the 10th of January, when late in the morning 3 German battalions issue from Connerré in the direction of the station (the branch line up the Dué valley did not exist), intending to follow the railway down the Huisne against Pont de Gesnes. They soon find there is much to be done before that point can be reached, for the French open a hot fire on the column as it advances, and show no intention of letting go their hold on the buildings in the low ground.

While the fight sways backward and forward another column of Germans may be seen moving down the valley on its far side towards Pont de Gesnes. It is a strong one of 5 battalions, a pioneer company, 2 squadrons, and 12 guns, but the slippery state of the road retards its advance, and its guns do not open fire until nearly 1 o'clock near La Belle Inutile. The French line the railway embankment, and seem too well posted to be likely to be dislodged without severe fighting, so this column returns to Connerré until its friends over the Huisne have cleared the ground.

They, when they found Connerré station and its adjacent buildings occupied, send 1 battalion against the station, and 1 battalion to the right by La Bourdonnière farm, in the flat meadow land. At noon they have carried the station and gained a footing in the large copse on your left, but the French remain unshaken on the crest of the plateau.

The German line is soon extended to the right by 2 battalions coming up from Beillé, but the enemy is continually making counter-attacks, for Chanzy has succeeded in communicating some of his activity to his subordinates, and in a little time, the third battalion which advanced from Connerré has to strengthen the German left.

At 2.30 p.m., firing breaks out in your left rear, and for a time the French guns direct a hot shell fire in that direction; it is an attack on the Couléon Chateau by two fresh battalions coming up from the north-east. In a little time the Germans carry this point, and the French giving way, retire to the western edge of the plateau, where the small farm of Le Chêne, slightly sunk below the crest line, affords them a strong *point d'appui.*

The fight now advances, now recedes across the plateau, for neither side can make good its advance beyond the shelter of the crest line.

Once again the French advance with resolution, but by now a fresh German battalion has come up in the centre, and another on the right, making 8 battalions, or about 6,400 men, on a fighting line of 3000 yards, with $6\frac{3}{4}$ battalions in reserve, of which only $1\frac{3}{4}$ are close up. No definite advance is made on either side, but the Germans left edges off to the west, and at dark has occupied the farms of Rollin and Courtillère on the southern end of the Le Chêne and Les Coherniéres ridges, while the French stand firm on the line of the last named farms. The chief fighting of the German centre column this day had been at Changé, $11\frac{1}{2}$ miles off to the south-west.

To see the ground, follow the track to its north-east end, then turn left (N.W.) and again turn right, so as to leave La Rougerie farm on the right. All this part of the ground is covered with oak scrub, and it is easy to see how the Germans might reach the eastern edge of the plateau and then be checked. Follow a lane to La Jouvellerie farm, and then turn across a field to a monument to those who fell in the fight, consisting of a brick pillar surmounted by an iron cross. To the north-east, towards Beillé, the ground is divided into cultivated fields, but fairly open; on your left all is wood. From the monument, follow the path rather to the east of north, and go through the wood until the valley of the Beillé brook is reached; here it is seen that this crest of the plateau is scarcely tenable, as the heights across the valley command it at a short range. Before reaching the valley you will have crossed a drive which descends to the left through a sunken way; go down this and take the first lane to the left which leads to La Ramée farm, which can be recognised by a large tower with a high roof rounded off at the ends. A hundred yards short of La Ramée turn up hill, but on reaching a pit on the right, turn into the field on your right, keeping outside the wood. Here a splendid view is obtained of the country to the north; north-west runs the narrow valley of the Cheronne, followed by the Bonnétable railway after leaving that of the Beillé. The village in the distance is St. Denis. To the north lies a large valley, drained by the Beillé, Etangs and Fleuret brooks, which is all cultivated in small enclosures and densely timbered. All the villages are hidden by the trees, but Chapelle St. Rémy, a scene of fighting on the 11th, lies about 3 miles to the north-west.

The whole district is very difficult to steer through, and the woods just here are not the same as shown on the German map of the battle of Le Mans. A field track leads along the northern side of the woods from La Ramée to Couléon Chateau; having gained this proceed towards the latter point. On your right, over some large fields, is the

farmstead of La Ratterie, from which the German right started in its advance on the 11th January. After passing through a strip of wood Couléon Chateau is reached, a large square building with stables attached, and with a succession of large out buildings stretching away up the gentle slope of the ridge. All the north-eastern side is surrounded with wood, and the French could have had no effective field of fire. Go down the fine old avenue, flanked on the right by meadows and high hedges, and on the left by the heather covered ridge and a most beautiful oak grove. After passing this grove, just short of the home farm of La Bosserie, turn to the left on to the ridge. Here on the table land, the fight surging backwards and forwards from crest to crest comes vividly to one's memory. Le Chêne, a very small farm building, lies below the western crest line, behind a fringe of young copse trees, after passing which, you reach the ground fought over on the 11th January, while the French were still far from being beaten.

On the 11th January the snow had ceased to fall and the atmosphere was clear and bright.

The French line faced south-east from La Chêne on the left to Les Coherniêres on a well-defined ridge running north and south 2000 yards westward. The farms in the low ground between these places and towards the Huisne were occupied as well as those of Fleuret and the Grande Métairie in the right rear.

The Germans had $9\frac{3}{4}$ battalions, 2 pioneer companies, 7 squadrons, and 48 guns in contact with the French left on the Le Chêne ridge, who were to continue the battle, supported by 5 battalions, 2 squadrons, and 12 guns from Connerré. The flank detachment of 3 battalions, 2 squadrons and 6 guns, which had gone round through Bonnétable, and had a sharp combat at Chantelongs, 7 miles W. by N., was to withdraw eastward again and descend on the French left rear by St. Célerin. The enemy was also to be harassed about Pont de Gesnes, and communication effected with the German centre column by 5 battalions, a pioneer company, 2 squadrons and 12 guns, moving down the left bank of the Huisne.

At 9 a.m., an hour after the original time for the commencement of the action, the guns on the left of the Huisne open on the French from the heights south-west of Connerré, but nothing more takes place, as yesterday's battle has so disorganised the troops engaged in it, that they require some time to reform, The right of these troops is thus disposed:—$\frac{1}{2}$ a battalion opposite Le Chêne, $1\frac{1}{4}$ battalion and a pioneer company north of the ridge at La Bosserie and Couléon Chateau, and $\frac{1}{2}$ a battalion at La Ratterie on the right, while $2\frac{3}{4}$ battalions are in immediate support. 6 squadrons with 6 guns are in the right rear at St. Hilaire, and $1\frac{3}{4}$ battalions, 1 squadron, and 30 guns have re-crossed the Huisne from Duneau, where they have passed the night. The positions gained yesterday have been partially entrenched.

While the units are being re-formed the fresh troops from Connerré cross the river and push forward a battalion in rear of the left down the valley, which at 11 a.m., occupies La Haute Perche, a small farm close to the Huisne, which the German guns on the other bank have set on fire.

At noon, this battalion and another from the left of the original line, carry Les Coherniêres, but the enemy reinforces his 3 battalions at this place with ½ a battalion of Marines, and no further advance can at present be made.

The French Commander, however, begins to find his line too extended, and determines to withdraw westward. Having deployed 3 battalions of Mobiles on the high north half of the Coherniêres ridge to protect the movement, he finally lets go his hold on the Le Chêne ridge. The half German battalion opposite the farm of that name, immediately take it with a rush, capturing 350 prisoners. At the same time 1¼ battalion push forward on the right, and after a sharp fight secure the Fleuret and Grand Métairie farms, with their right protected by the Fleuret brook.

The resistance becoming much lighter 2 battalions of the German left, reinforced by another of those coming up from Connerré, press across the low ground, and gain the Les Coherniêres ridge, where they are quickly followed by 2 guns, which open on the retiring columns from a position just north-west of Les Grands Vaux.

The advance is slow, but at 4 p.m., the whole of the Les Coherniêres ridge is clear of the French, and 2 battalions have managed to move down the railway and cross the Gué brook. Here they occupy some houses, but are soon driven back by a force composed mostly of Marines, which is led by Admiral Jaurès, the Commander of the French left wing, in person.

The column on the other side of the Huisne, finding the enemy too well posted to suffer much loss, has left 1¾ battalions, with 6 guns at La Belle Inutile, and has retired to Connerrè, so as to be able to cross the river if required.

The troops lining Les Coherniêres ridge consisting of 6 battalions and 4 guns, try to take the farms in the deep valley of the Gué brook, but all the Loresse ridge is entrenched and the French cannot be driven further westward.

The troops from Le Chêne and the Grand Métairie and Fleuret farms have passed round the north end of Les Coherniêres ridge, and nearly reached Lombron at the end of the Loresse ridge, but the enemy are here too strong for an attack in the dusk, and so the German battalions retire to the north-east towards Chapeile St. Rémy, where they are joined by the flanking detachment from Chanteloup, which has had a slight action at St. Célerin, and with it and the Cavalry on the right, form a force of 8 battalions, 1 pioneer company, 8 squadrons and 18 guns. So at the end of the day the German XIIIth Corps has in first line 17 battalions on a front of about 5 miles.

To see the ground turn north along the road, which passes Le Chêne, and take a cart track to the left (W.), just before reaching the Couléon Avenue. The country to the north is all flat, and divided into meadows and fields by large thick hedges containing much timber. About 1000 yards further on turn left again (S.) to the farm of Les Grands Vaux. The Coherniêres ridge is immediately on your right, gradually increasing in height to the northern end which is covered with wood; its eastern slopes are steep and crossed by hedges impeding an advance, while the

ground in front as far as the Le Chêne ridge is almost completely open. In fact, this ridge would have been extremely difficult to carry if it had not been turned at its southern end. Turn right (W.) and ascend the hill by a muddy narrow lane. Les Coherniѐres is an ordinary farm, just over the watershed line, surrounded by very small orchards and cultivated fields.[1]

Follow the lane which branches off to the right (S.W.) just before Les Coherniѐres is reached, go on to La Porte, a cottage and a barn. At La Porte the position of the German guns is on the other side of the depression on your right (N.); it is at the present time surrounded by woods. Before is the large Loresse Chateau, and in the hollow below the farms of Le Cassoir and Simonniére, which the French held successfully.

Both sides of the valley of the Gué brook are covered with large fields, affording a good field of fire.

The Loresse ridge is well-defined and has a low continuation for about 2 miles north of the Chateau. Lombron (1400 inhabitants) lies on the western side of a depression 1000 yards north of the Chateau, and the hamlet of Les Jouaziѐres on the same side of another, 1000 yards south of it.

Make the best of your way south-west into the valley, and gain the lane leading over the depression to Les Jouaziѐres. Take the first turn to the left (S.E.) by Les Roussiѐres and cross a spur into the Huisne valley. From the knoll at the south of the ridge on your left, a fine view is obtained over the Huisne valley from Connerré to Pont de Gesnes.

Below is the road along which the Marines of Admiral Jaurѐs made their gallant counter-attack on the German left. Half way to Pont de Gesnes on the left of the road will be seen a shabby monument to their memory.

The Huisne at Pont de Gesnes is extremely picturesque, opening out below the mill into a large pool crossed by a fine old stone bridge.

To reach the station, which is about a mile from the bridge, turn to the right after crossing the latter, along the new road between the river and the railway.

The walk this day is about 12 miles.

---

[1] The map of the battle does not correctly mark the lanes at this point.

(To be continued.)

MEMORANDA

RELATING TO THE

SORTIE, GIBRALTAR, 27 NOVEMBER, 1781.

COMMUNICATED BY

THE SECRETARY.

[The following detailed account of the Sortie from Gibraltar, 27 November, 1781, is taken from a MS. in possession of the R.A. Institution.—*H. W. L. H.*]

LAST night an order was given for a detachment to assemble on the Red Sands at 12 o'clock at night, consisting of the 12th and Hardenburgh's Regiment complete, the Grenadier and Light Infantry Companies of all the other Regiments (who are to be completed to their full establishment from the Battalion Companies), 1 captain, 3 lieutenants, 10 non-commissioned officers, and 100 men of the Royal Regiment of Artillery, 3 engineers, 7 Officers overseers, 12 non-commissioned officers, and 160 workmen from the Line (except the 12th and Hardenburgh's Regiment), and 40 workmen from the Artificer Company. Each man to carry 36 rounds (or more), a good flint in his piece, and another in his pocket. Brigadier Ross to command the detachment; no volunteers will be allowed. The troops intended for the Sortie are to be formed as follows in three columns:—

LEFT.	CENTRE.	RIGHT.
Lieut.-Colonel Trigge.	Lieut.-Colonel Dackenhausen.	Lieut.-Colonel Heigo.
Grenadiers and Light Infantry of the 72nd Regiment.	Grenadiers and Light Infantry of 39th and 73rd Regts.	Grenadiers of Reden's and Lamott's Regiments.
Sailors.	Workmen.	Workmen.
Artillery.	Artillery.	Artillery.
12th Regiment.	Grenadiers of 56th and 58th Regiments.	Hardenburgh's Regiment.
Light Company of 58th Regt.	Major Maxwell.	Light Company, 56th Regt.

The whole marched off from the Red Sands a quarter before three o'clock in the morning in the above order.

The Grenadiers and Light Infantry Companies in the front of each Column were ordered as soon as they had passed our barriers to move on briskly, and not to fire on any account, if possible to avoid it, until they got to the enemy's advanced works, attack the guards, and as soon as they had defeated them form in the rear of the batteries, in

order to protect the workmen and Artillery during the destruction of the works. The Grenadiers and Light Infantry, above-mentioned, were fired on by the enemy's advanced sentries or patrols, and some grape shot from the forts fell amongst them as soon as they had passed our barriers, which they took no notice of, but rapidly advanced to attack the works, which they carried with very little loss, for the enemy made but a faint resistance; they then formed as above. The workmen were instantly ordered into the batteries, and dismantled them as expeditiously as possible, then marched in the Artillery and set them on fire, spiked up the ordnance, which consisted of 10 mortars of inch, and 18 cannon, 26-pounders, all brass. In the meantime, the 12th and Hardenburgh's Regiments formed 50 paces on this side the enemy's works, in order not only to protect the workmen, but likewise to support the Grenadiers and Light Infantry Companies, in case they should be attacked and repulsed; the Light Infantry and Grenadier Companies of the 56th and 58th Regiments were formed in four separate bodies, 50 paces in the rear of the 12th and Hardenburgh's Regiments, under the command of Major Maxwell, as a corps of reserve to act as occasion might require: this, I believe, was the Governor's disposition, at least, it is my idea of it.

When the works were dismantled and set on fire, all the ordnance spiked and the flames had made a sufficient progress, we prepared to retreat in nearly the same order as we advanced, with this difference, that our advance was rapid, our retreat slow, covered by Major Maxwell and his four Companies of Grenadiers and Light Infantry, to which were added the Grenadiers and Light Infantry Companies of the 12th Regiment; this body formed our rear guard. It was 20 minutes past 3 o'clock before the last of the troops had marched out of Landport Barrier, and the whole were in again by five, with the loss of only four privates killed, one officer, two sergeants, and twenty-two rank and file wounded. Five of the latter were sailors. So much for the attack and retreat.

Reflection.—This is barely credible at the first view, that the above detachment should march out, attack, and completely destroy the enemy's advanced works, spike all their ordnance, blow up the magazines—works that had taken them 14 months in erecting, with a very great expence and loss of men, exclusive of 16 months previously to that in preparing the materials; those works at 1200 yards distance from the garrison, covered and flanked by a number of pieces of cannon and mortars at only 600 yards distance, and in the front of an encampment of 10,000 or 12,000 men—with so small a loss, but no plan could be better constructed, and the event shows it was well executed. But, I repeat, at the first view it is barely credible that the above should be done in so short a time and with so small a loss, but the enemy had been lulled into security, for the works were not only weakly guarded but ill-defended; their surprize was so great that, instead of attempting to repulse us, they thought of nothing but securing themselves by flight; for they totally abandoned their lines and retired into the two forts, and even in them they did not think

themselves secure; so great must be their consternation, otherwise, how is it to be accounted for their not firing upon us, even from their forts? Fort Philip particularly was only at 600 yards distance, nay, much nearer to the Grenadier and Light Infantry Companies of the 72nd Regiment, that was posted betwixt the works and the Fort, and in our retreat they fired but very little, and that little very ill-directed, when they must know (if they had any knowledge left) that we had a very narrow pass into the garrison, particularly from our advanced barriers to Landport, and where they might have directed all the fire of their guns and mortars.

The detachment of the Royal Artillery ordered for this service was commanded by Captain Whitham, Lieutenants Cuppage, Seward, and Glasgow, and consisted of 10 non-commissioned officers and 100 men. The three Subalterns had each an equal number of non-commissioned officers and privates allotted them, and were attached one to each column.

Each non-commissioned officer was provided with a lighted slow and paper match, and two portfires (which were carried in a 3-pounder empty cartridge, pricked in holes to give air). The portfires were lighted after the combustibles were fixed. One hammer and six spikes to spike up the ordnance. Each private was provided with a fire-faggot and 10 devils (or hand-lights), which he carried in a bag slung across his shoulder, and also had two portfires each.

Upon the Artillery entering the works their first business was to spike all the ordnance, which being completed, the Engineers reported that the workmen had totally dismantled the works, when the Artillery Officers instantly ordered their people to fix their faggots and devils to the different parts where the materials were collected, and on the signal given at St. Carlos every man sat fire to his faggot and devil, and the wind springing up about that time made it communicate very rapidly and successfully to the whole. Soon after this Captain Whitham reported to Brigadier Ross that the business was perfectly completed, and that the blowing up of the magazines might soon be expected. The whole were ordered to retreat in the manner before described.

Six pieces of brass ordnance were found in each of the two gun batteries, which they term 24-prs., mounted on new garrison truck carriages, with sponges, rammers, &c., complete: the guns were above 9 feet in length, carriages high, and seemingly constructed to allow great elevation; batteries complete, and ready for immediate service; platforms short, plank laid parallel to the sill of the embrazure, with a great slope to diminish the recoil, merlons about 10 feet high with fascines, and filled up with sandbags, &c.

The Western Mortar Battery was about 60 yards long, and from 12 to 15 feet high, divided into three parts lined with fascines well made and strongly picketed together. In the right division of the battery were two large brass 13-inch mortars, their beds were in frames of

strong timber sunk in the ground, so that their direction was invariable: one of them was loaded, which discharged in the general conflagration. The centre and left divisions of the battery had each 3 brass 26-prs., fixed in frames of strong timber, their breech sunk about 2 feet below the surface; over the first reinforce of each was a cover of wood in form of an umbrella, with a covering of oil cloth the whole length of the gun. They were all laid in the direction of our camp, apparently at about 40 degrees of elevation.

In the Mill, or St. Carlo's Battery, were mounted 7 mortars of 13-inch and one of 11, all brass, whose beds were seated in the same manner with the two above described; one grand powder magazine, situated at about 150 yards in the rear of the eastern angle, and another on the western angle for fixt ammunition, not quite so remote from the works (both of which blew up after our return); there was also a capacious bomb-proof in the rear, nearly central, with a number of splinter-proofs of less note. The epaulment or face of the works, about 14 feet in height, well faced with fascines, and a space in front of the mortars lined with strong oak plank, at least 7 inches thick, which they had braced together by strong iron work. The battery was well provided with traverses of about 10 feet square, and nothing seemingly wanting to render it as complete as could be wished.

The following Officers, &c., were taken prisoners upon this occasion:—

1 Captain (who died of his wounds) and 1 Lieutenant.
1 Corporal and 9 Privates.

The Governor's Orders on the 27th:—

"The bravery and conduct of the whole detachment, Officers, Seamen, and Soldiers on this glorious occasion surpasses The Governor's utmost acknowledgment."

Names of Officers and Non-commissioned Officers of the Royal Artillery who were out on the 27th November, 1781, with the sortie:—

Captain Abraham Witham.

Lieutenants William Cuppage, Thomas Seward, George Glasgow.

Sergeants Robert Paterson, William Finney.

Bombardiers James Wilson, William Bagshaw, John Stevenson, Titus Bratt, John Ralph, James Fraser, Daniel Fleany, William Budd; and 100 Privates.

NOTES

ON THE

DUTIES OF NEWLY-APPOINTED ADJUTANTS.

BY

MAJOR J. C. GILLESPIE, R.A.

---

1. The clerk should be directed to show every paper or document that comes into the office to the Adjutant.

2. All documents passing through the office should be registered.

3. Letters written by the Officer Commanding the Division, and correspondence arising therefrom, should be copied.

4. Other correspondence passing through the office should be registered only, giving, however, a sufficient description in the "Subject" column to enable the original to be referred to if necessary.

5. A receipt should be obtained for all men's documents sent out.

6. In referring to a man, his regimental number, rank, initial of christian name, and battery should be stated.

7. Every memo. forwarding other papers should have a heading describing shortly the nature of these papers, so that when returned from a Battery it forms a receipt.

8. Every few days the register should be looked over to see that receipts have been obtained for all documents sent out, that papers sent out to Batteries have been returned, and that answers have been received to all letters written.

9. Changes on lists kept in office, such as "List of Returns," "Employed Men," &c., should be made as they occur.

10. Once a month, at least, a thorough inspection should be made of everything in the office, especially the letter and register books. The printed books should be examined to see that all corrections have

been made from the last General Orders, Army Circulars, and R.A. Regimental Orders, and that the orders themselves have been pasted in their guard books.

11. An office copy should be kept of all returns compiled in the Division Office, and any corrections or remarks which may afterwards be made on the original should be inserted on the copy.

12. The Adjutant should keep a Letts' or similar diary to note future transactions: thus, if he wishes to be reminded that there is to be a foot parade for the Division on the following Wednesday he writes down in the diary opposite the Tuesday following "Order Foot Parade."

13. The Adjutant should always remember that his duty is to assist the Batteries in every possible way, and he should relieve them of all work that can be done in the Division Office. Discharges, the documents which accompany Applications for Courts-Martial, Records of Declarations of Courts of Enquiry on Illegal Absence, are amongst the documents which should always be prepared in the Division.

14. On a Battery first arriving in a district the Adjutant should send it a carefully prepared list of returns, showing not only those sent in to the Division but all due by the Battery. It should show the date the Battery has to render them, the person to whom sent, the number of Army Form, or, if in manuscript, a blank form should accompany the list. He should also keep a book in which important District Orders and all local regulations connected with the rendering of returns and methods of carrying on correspondence should be entered, and should forward this book to Batteries on their first arrival.

15. The word "pressing" shonld be used sparingly in official correspondence; it should never be employed, unless its omission will involve a failure of discipline or pecuniary loss.

16. "Confidential" correspondence should be confined solely to matter which for the sake of discipline it is better not to make public; there is no more troublesome nor less effectual way of conveying orders than in confidential letters, which should hardly ever be used for this purpose.

17. Whenever books are lent out of the office a note should be taken of the transaction.

18. Office work should not be allowed to get into arrears; every paper in the office should be disposed of each day before the latter is closed.

19. The Adjutant should have Section VI. of the Queen's Regulations almost by heart, and should, when anything comes into the office out of the usual routine, refer at once to his printed books by Queen's Regulations, &c., and the course of action will seldom fail to be found.

20. All correspondence for the Officer Commanding the Division should be got ready before his arrival and placed on his table, and when reference in any letter is made either to a book or previous correspondence it is well to have the latter open for his inspection.

21. Lastly, all letters should be thoroughly courteous; personal feeling or sarcasm should have no place in official correspondence.

Daily.

1. Open letters.

2. Look at List of Returns to see that none are missed.

3. Look at Diary.

4. Look carefully through Morning States. Note especially whether there are any absentees for whom deserter's reports should be sent in, or Boards of Illegal Absence held, men in prison for whom routes are required, prisoners in hospital, &c.

5. Look at list of eight-day prisoners to see that they are regularly reported.

6. Look through Guard and Minor Offence Reports to see that all entries have been made in accordance with the Queen's Regulations, and that no prisoners are left undisposed of.

7. Read the orders very carefully.

8. Sign or initial postage book.

9. Issue orders for next day.

A SHORT ACCOUNT

OF SOME

PRACTICE AT MOVING OBJECTS,

IN THE

WESTERN FORTS DISTRICT, ISLE OF WIGHT,

BY

LIEUT.-COLONEL E. LYONS, R.A.

THE Annual Station Practice of the Western Forts, Isle of Wight, was carried out on the 14th October. The following table summarises the results :—

Name of Work.	Number of rounds fired at target.	Nature of gun.	Number fired from.	Projectile and charge	Nature of Battery.	Height of Battery.	Ranges varying		Nature of target.	Speed of target, (miles per hour).	Results of Rounds.				Mean point of impact of shots.	
							From	To			Hits.	Range.	Over.	Short.	Over.	Under.
						feet.	yds.	yds							yds.	yds.
Warden Point Battery, (Target going out).	6	9-inch R.M.L., mounted on W. I. sliding carriages and dwarf traversing platforms.	3	Palliser shot fitted with gas checks. Battering charge, 50 lbs. P.	Barbette.	100	1600	2050	20 ft. old boat, surmounted by open conical wooden frame and small flag, tow line 200 yds. long.	4½	2	1	2	1	Range.	
Hatherwood Battery, (Target going out).	8		4			272	1700	2000		4½	1	—	2	4*	3	—
Needles Battery, (Target going out).	12		6			240	2000	1600		4½	—	—	11†	—	53	—
Needles Battery, (Target returning).	6		6			240	1700	1500		5	—	—	3	3	2	—
Hatherwood Battery, (Target returning).	4		4			272	2300	1800		5	—	1	3	—	26	—
Warden Point Battery, (Target returning).	3		3			100	2150	2000		5½	—	—	3	—	47	—

* 1 round omitted as exceptional, being 200 yards short.

† 1 shot fired as trial shot by Officer Commanding the Battery omitted.

Number of feet right or left omitted, nearly all shots having been in line.

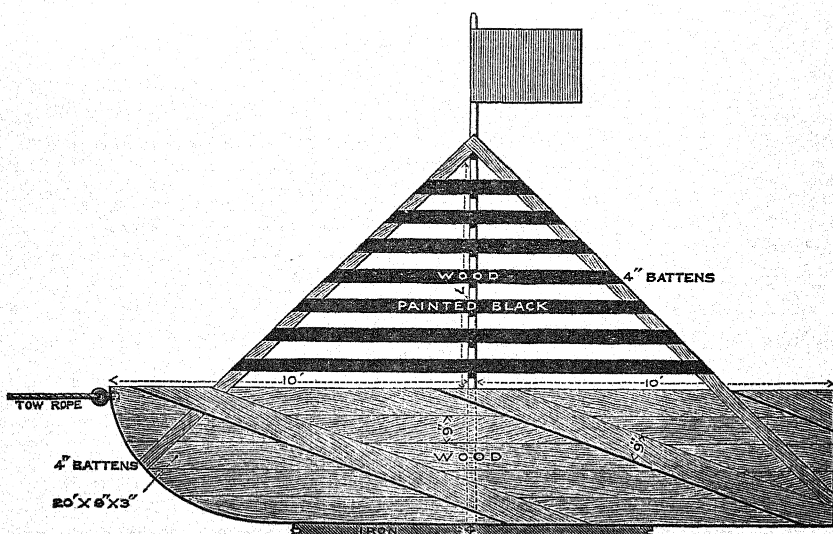
For the information of those unacquainted with the defences of the Needles entrance to the Solent, it may be briefly stated that the Channel is confined between the Isle of Wight shore and a shingle bank which runs parallel to it, at a distance of about 2000 yards. Roughly

speaking, about 1200 yards only of the centre of this channel is available for large vessels. It extends from Hurst Castle, which is situated at the end of a long shingle spit running out from the Hampshire Coast, half way across the Solent, to the Needles, a distance of about four miles. Directly opposite Hurst Castle is Cliff End Battery; and then Warden, Hatherwood, and the Needles Batteries, occupy successive promontories projecting into the Channel at nearly equal distances apart, and in the order named. At spring tides, the current varies from 5½ knots an hour between Hurst Castle and Cliff End Battery, to 3½ knots, opposite the Needles.

The Practice was carried on from a portion only of the Armament of Warden, Hatherwood, and the Needles Batteries, as some of the guns in these works had been fired at Battery Practice, and others, including those of a heavier nature, were temporarily dismounted for alterations to their carriages, or other reasons.

It was originally intended to fire at targets, specially prepared to drift with the strong tides before-mentioned, but when a steamer was made available, two old four-oared boats were purchased, and a rough triangular wooden frame-work, surmounted by a small flag, was lashed upon the gunwale of each. The tow-rope used was 200 yards long; but half that length would have been amply sufficient for safety. The first boat was hit twice, and when she filled, the other, which had been towed close behind the steamer, was allowed to drop astern, and take her place. The steamer's speed was greatly retarded by dragging this water-logged boat, until a lucky shot cut her adrift altogether.

A sketch of a proposed target, which would probably answer well under similar circumstances, is appended. Several of this nature



might be towed, one behind the other, to represent a squadron, without materially affecting the speed of the towing steamer. They would be cheap, easily constructed, and practically everlasting.

Two rounds only were fired from each gun as the target was towed past the Batteries down channel, and one on its return. This had been arranged beforehand, when it was anticipated that a much higher rate of speed would be obtained, but all three rounds might easily have been fired during the target's seaward progress.

A Watkin's depression range-finder was in use in each work. An assistant to the observer at the telescope read the scale, and called aloud every 25 yards alteration of range; while the Officer in command of the Battery directed the number of minutes allowance to be made on the deflection leaf for the estimated speed, duly corrected for the angle at which the target was moving, and the force of wind.

No. 1 inserted the tube in the vent when the gun was nearly laid, No. 5 standing clear and not touching the lanyard until the word "Fire" was given as No. 1 jumped down. The men were well drilled beforehand in this manner, and the delay thus caused, was found not to exceed one second of time.

In estimating the quality of this practice, it should be considered that the firing was comparatively slow and deliberate, the Batteries were little delayed or impeded by smoke, and the speed of the target was only about one-third of what might be expected under service conditions. On the other hand, the target was a very small object indeed, as compared to an enemy's vessel, Officers and men were wholly inexperienced in firing at moving objects, and the laying might be much improved with greater practice, and better means of instruction.

The principal lessons taught by this experiment, with regard to practice at moving objects, appear to be as follows:—

Elevation presents the only real difficulty: the amount of deflection allowance required is comparatively easy to judge.

The Nos. 1 at heavy guns mounted for Coast Defence and firing at rapidly-moving objects, call for very careful selection, and require special training and constant practice. Perfect matériel is wasted unless the personnel is sufficiently skilful to turn it to full account, and we cannot afford, with our present heavy guns, to throw away even a single round which costs so much, takes so much time in preparation, and is so destructive in its effects when it attains its object.

The duties of Officers Commanding, and Nos. 1, must be made as simple as possible; there is no time for elaborate calculations.

The matériel must be all perfect, and in perfect working order, well tested beforehand by actual experiment. This practice has brought to light several weak points, in which there is room for improvement.

Practice at moving objects from Coast Batteries, in peace time, under conditions fairly resembling those of actual warfare, seems perfectly practicable, at least at some stations.

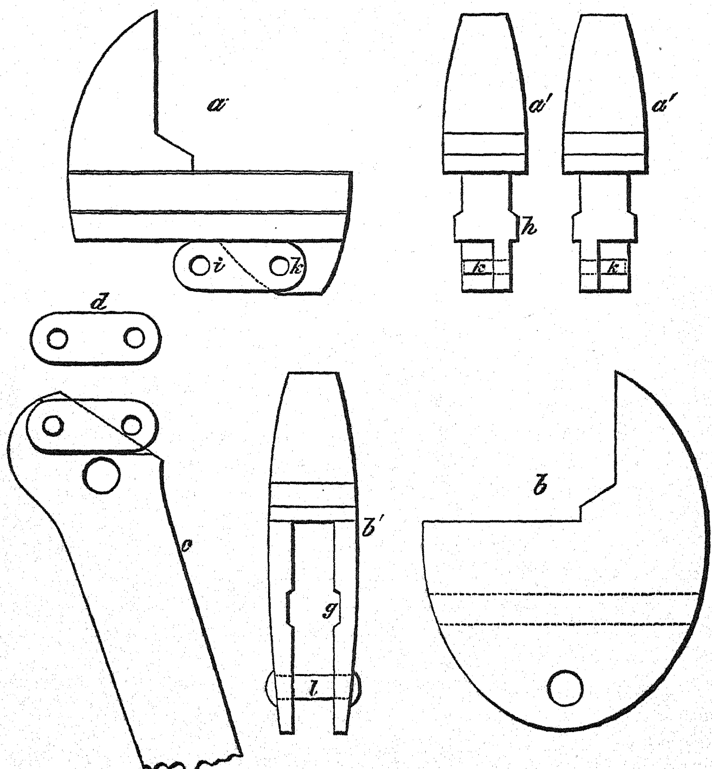
Carefully conducted experiments in fighting Coast Batteries at night time by electric light would be novel and highly interesting. They might be carried out with blank ammunition at moving targets or vessels, Nos. 1 judging and reporting the probable result of their fire, and would afford much valuable information on the details of a subject on which we are at present very ignorant.

SHORT DESCRIPTION
OF
SHWARTZKOPF'S WRENCH.

BY

CAPTAIN E. H. WALKER, R.A.

I HAVE made a sketch of the mechanism of this wrench, which is the one used by the Egyptian Field Artillery, in the hopes that it may be of interest to the Officers of the Regiment.



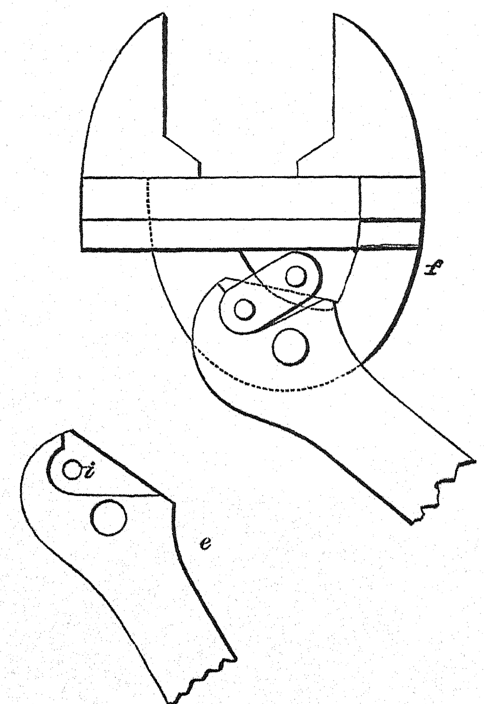
a a' Plan and sections moveable jaw.
b b' Do. do standing jaw.
c Lever handle.
d Loose piece.
e Plan head of lever.
f Plan of wrench in action.
l Bolt.

The wrench is automatic, requiring no adjustment. The head of the nut regulating the span of the jaws by the simple moving of the lever handle.

Parts.—The instrument consists of the following parts:—

a. Moveable jaw.
b. Standing jaw.
c. Lever handle.
d. Loose piece.
l. Bolt.

Action.—The moveable jaw has a rib at the bottom (*h*) which works in the slot (*g*) in the standing jaw.



The loose piece (*d*) has two holes into which fit the pins (*k*) on the flange of the moveable jaw, and (*i*) on the flange of the lever handle. The bolt (*l*) passes through the two sides of the standing jaw and the lever handle. The motion of the instrument is the same as a double lever.

a′ b′ are elevations of the moveable jaw and standing jaw respectively; *f′* shows a plan of the wrench partly open, the upper side of the standing jaw being disregarded in order better to show the working.

Dimensions.—The length is about 16 inches, the weight about 2 lbs. 8 ozs.

The spread of the jaws is a mechanical detail which would present no difficulty in adapting the principle of the wrench to any sized nut.

The instrument in my possession has the greatest span 1·75 inch, and least ·5 inch.

PRÉCIS
AND
TRANSLATIONS.

FRANCE.

I.

REVUE MILITAIRE DE L'ETRANGER.
15th JULY, 1884.

BY

MAJOR J. H. G. BROWNE, R.A.

The Russian School of Gunnery.

Uniformity in the instruction of the Arm of Artillery was formerly ensured in Russia by the aid of "*Corps d'Instruction*," viz., a Field Battery, a Battery of Horse Artillery, and a "Cossack" Section attached to the Guard, to which a certain number of Subaltern Officers, N.-C. officers, artificers and gunners were sent every year. The period of instruction was one year, and, during that time, a complete course of Artillery instruction was gone through.

The "*Revue*" has already made known that an Imperial decree of 26th March, 1882, had ordered the suppression of the "*Corps d'Instruction*," and their supersession by a School of Gunnery for Artillery Officers. This School has been created by an Imperial decree, 2nd April, 1882, and we can now give an account of its organization.

Object and Organization of the School of Gunnery.

The objects in view are,—

1. To prepare Senior Artillery Officers, by theoretical and practical work, to perform the duties of Battery Commanders.

2. To develop the instruction of Gunnery in the Artillery.

3. To spread through the Artillery rational ideas with regard to the employment of fire in action.

4. To ensure uniform teaching with regard to gunners. The School of Gunnery is placed under the direct orders of the Grand Master of the Artillery, and is inspected in every particular by Officers deputed by him.

A special staff of studies is attached to the School, charged with the discussion of all questions relating to instruction. The School is directed by a Senior Officer of the rank of Colonel or Major-General. It comprises a permanent and variable strength; a Field and a Horse Artillery Battery of instruction; and a detachment of non-combatants.

The Field Battery comprises 4 light field guns and 2 mountain guns (horsed), and 2 heavy and 4 light guns, and 8 wagons (unhorsed). The Horse Artillery Battery contains 6 guns and 2 wagons (horsed), and 4 wagons (unhorsed).

The administration and accounts are entirely under the direction of the School. They are subject, as far as the School itself is concerned, to the rules for the administration of the fractions of troops forming Corps; and, as far as the Batteries are concerned, to the rules for the administration and accounts of Companies and Squadrons.

The permanent effective strength is as follows:—

(*a*.) Staff.

1 Director of the School (Colonel or General).
1 Superior Officer, charged with superintendence (Colonel).
1 Officer, assistant to the Superintending Officer,
1 Adjutant, } Subaltern Officers.
1 Treasurer and Quartermaster,
1 first class Surgeon,
1 Veterinary Surgeon, } Departmental Officers.
1 Accountant,
1 Riding Master,
1 Roughrider.
1 first class "Feuer-werker." } Combatant men belonging to troops.
4 armourers.
1 assistant to the Quarter-Master Armourer,

There are besides as non-combatants—

2 first class Secretaries.
2 second class Secretaries.
3 third class Secretaries.
1 "Feld-saker Medecin" of first class.
1 "Feld-saker Medecin" of second class.
1 "Feldscher Veterinaire" of first class.
1 "Feldscher Veterinaire" of second class.
1 sick superintendent.
4 room overseers.
1 cutter and fitter.
9 first class artificers.
10 second class artificers.
3 cooks and bakers for the Batteries and the Detachment of non-combatants.
21 soldiers in charge of the horses belonging to the State.
4 drivers.
13 orderlies.

Officers' riding horses.

1 for the Superintending Officer.
1 for the Assistant to Superintending Officer.
1 for the Adjutant.
35 for the Officer Students.
3 remounts.
There are besides 5 fatigue horses.

(*b.*) Batteries.

	Personnel.		Riding horses.	
Officers.	Field Batteries.	H. A. Batteries.	Field Batteries.	H. A. Batteries.
Commandant of Batteries (Colonels) ...	1	1	—	—
Subaltern Officers	5	4	5	4
Men.				
"Feldwebels"	1	1	—	1
Armourers	1	1	—	1
"Feuerwerkers" first class	5	3	—	3
"Feuerwerkers" second class ...	6	7	—	7
Trumpeters	3	3	3	3
Privates, bombardiers (pointeurs) ...	6	6	—	63
Privates, bombardiers (artificers) ...	6	6	—	
Privates, bombardiers	30	28	—	
Privates, gunners	123	117	—	
Privates, orderlies	7	6	—	

There are besides for the Field Battery,—

1 remount riding horse.
24 draught horses for the 4 light pieces.
16 " " mountain section.
3 " " spare.

For the Horse Artillery Battery,—

8 riding horses, spare.
10 " " remounts.
36 draught horses for the 6 guns.
12 " " 2 wagons.
5 " " spare.

The Director of the School is chosen by the "Grand Maître" of the Artillery, and confirmed in his office by Imperial decree. He has under his orders all the "*personnel*" of the School, and possesses with regard to interior economy all the powers of the Commander of a Division. He sees that the instruction is in conformity with the plan of study, and with the rules, regulations, and synopsis drawn up for that purpose; and he superintends the work of the Batteries. He sends an annual report of the operations of the past year to the "Grand Maître," who forwards it, with his remarks, to the Minister-at-War, to be submitted to the Emperor. The Director of the School is a Consulting Member of the Artillery Council. He chooses all the Officers of the School and Batteries. He has the right of nominating and dismissing all the individuals who have civil employments in the School. He can give 28 days leave to the "*personnel*" of the variable strength. In case of

sickness or prolonged absence, the Director of the School is replaced by the Senior Officer of the permanent strength by special order of the "Grand Maître" of the Artillery.

The Superior Officer charged with the superintendence of the Officer Students is their immediate chief, and possesses with respect to them, the rights of the Commandant of a Battery. He sees to the maintenance of discipline, to the execution of the rules of the School, and to the preservation of order during the course.

The Assistant to the Superior Officer replaces that Officer in the particular services which the latter wishes to entrust to him. It is his duty also to keep the register relating to instruction, to draw up the synopsis of the Officers' studies, in accordance with the decision of the Director, and to keep the library, models, tools, and materials used for instruction and for practical work. He signs the lithographed manuscripts, and he is responsible for keeping the catalogues and registers, as well as for the maintenance of material. The rights and duties of the Accountant, Treasurer, Adjutant, and Riding-Master are fixed by general rules. The duties of the Commandant of the Detachment of non-combatants, and of the Chief Apothecary are confided to these Officers by the Director. The Doctor and Veterinary Surgeon are selected among the Military Doctors and Veterinary Surgeons of the general Council of the Artillery, and by the Medical Council, and are nominated by the latter. The Doctor has to give his services gratuitously to all the "*personnel*," permanent or variable, of the School, to the families, and to the servants who belong to it. The Veterinary Surgeon has to look after all the horses, including the riding horses which are the private property of Officers.

The Commanders of Batteries possess the powers of Commanders of Batteries in the Army; and, independently of the duties laid down by the rules, they direct the practical firing of the Officer Students, in accordance with the synopsis chosen, and with the wishes of the Director.

The Battery Officers are directly under the orders of the Battery Commander. They perform the duties and possess the powers laid down by the regulations. The gunners, drivers, and artificers are recruited from among the young soldiers; the Secretaries are drawn from the School of Secretaries, and appointed by the General Staff; the "Feldschers" are appointed by the General Council of the Medical Staff; the re-enlisted men are 4 Feuerwerkers or armourers and 3 non-combatants of the Staff of the School; the Feldwebel and 5 Feuerwerkers of the Field Battery; the Feldwebel and 4 Feuerwerkers of the Horse Artillery Battery.

Special Arrangements.

All the Superior and Subaltern Officers of the permanent effective strength are kept in the Register of the School, and are promoted to superior ranks, according to the rules in force in the Artillery. They wear the uniform of the Corps to which they belonged before entering the Schools.

Officers and men of the permanent effective strengths who obtain leave of absence for more than four months, are struck off the strength of the School. The men of the Staff of the School and of the Field Battery wear the uniform of a Service Field Battery. The men of the Horse Artillery Battery wear that of a Service Battery of Horse Artillery, but none of them wear any numbers on their shoulder-straps and caps.

In order to train "Feuerwerkers" for the Batteries of the School, an instruction detachment has been established on the same principles as those existing for the instruction of detachment of Artillery Brigades.

The Batteries which belong to the School are exempt from all service excepting home defence. No reserve of material is kept either in the School or in the Batteries. The seat of the School is St. Petersburg, but during the summer, it is located at the Camp of Oust-Ijora, or at that of Krasnoe-Sélo.

The provisions, materials, funds, &c., necessary for the School are furnished by the Artillery, Engineers, and Commissariat belonging to the Military District of St. Petersburg. The books which the School takes in from Foreign Countries are free from duty. The School, moreover, receives at cost price, all the Publications of the Topographical Section, and the Topographical instruments necessary for instruction. It also receives a certain number of publications gratuitously.

Officer Students.

The Officer Students who form the variable strength of the School are recruited among the most senior Captains of the Garrison, Field and Horse Artillery, and the first and second Captains of the Cossack Artillery. They are nominated by the General Council of the Artillery, and by the Council of the Cossack Troops, and selected among the Officers borne on the list to discharge the duties of Battery Commanders. But Officers belonging to the Military Districts of Eastern and Western Siberia and of Turkestan, are not sent to the School.

The number of Officers selected every year to go through the course does not exceed 35, that is to say, about 10 for every 100 Batteries. Officers who, although not doing duty with Batteries, are nevertheless enrolled as candidates for the command of a Battery, can equally be sent to the School of Gunnery, and included in the maximum number of 35. If the Officers of the permanent Staff of the School are selected to be Officer Students, they give up their special duties, and are ultimately replaced by other Officers of the permanent effective strength, selected by the Director of the School. During their time at the School the Officers of the variable strength continue to belong to their Corps; they are not called upon to fill the vacant posts of Commanders of Batteries until after the completion of the School course, and are promoted to superior rank according to the rules in force, preserving their seniority. Their passage through the School of Gunnery is mentioned in their Records of Service, as well as the mark obtained on leaving, if it is "good" or "very

good." Those who have particularly distinguished themselves may, besides, at the end of the course, be proposed for exceptional rewards, without however being eligible for promotion to senior rank. During the course they cannot obtain leave except for urgent reasons, and that leave cannot exceed 28 days, without their being struck off the lists of the School. Those also who for any reason whatever have not finished the course, may, if they have obtained good marks, be allowed to go through it a second time, but in this case they are not allowed travelling expenses, unless they have been struck off on account of sickness.

The Officer Students bring their soldier servants with them. When a soldier servant is sent back he is replaced by a man taken from the nearest local troops.

Instruction.

The complete course of the School lasts 7 months, from February to September. It is divided into two periods; the first, from February to May, is devoted to theoretical instruction and practical work; the second, from May to September, is entirely devoted to practical work.

Committee of Studies.

All questions concerning instruction are examined by a Committee of Studies, composed by the Director of the School as President, of the Battery Commander of the School, of the Superior Officer entrusted with the superintendence of the Officer Students, of the Professors, and of the Director of the practical work. The Assistant to the Superintending Officer, who performs the duties of Secretary.

The Committee is charged with,—

(*a.*) The examination of the synopsis, both of the course of the School and of the practical work of the Officers' studies.

(*b.*) With the choice of works and material for the studies.

(*c.*) With modifications in the synopsis of instruction in practical gunnery.

(*d.*) With making regulations for the practical work, whether at home or in the field, executed by the Officer Students.

The Committee of Studies is called together by the Director of the School; the decisions are taken by the majority of votes; in case of an equality of votes, that of the President decides; but, if the Director is not of the opinion of the majority, he can supersede it, and carry out his personal decision, referring the matter to the "Grand Maître" of the Artillery, by sending him a copy of the proceedings. All the decisions of the Committee, concerning the questions which belong to paras. (*a*) and (*b*) are immediately put into execution by the Director; but the decisions on questions referring to paras. (*c*) and (*d*) must be previously submitted for the approbation of the Grand Maître of the Artillery.

Synopsis.

The theoretical instruction of the School comprises,—

(*a.*) Artillery.

1. Study of the ballistic properties of field and mountain guns, and of rifles of different patterns.
2. Principles of the construction of telemeters.
3. Notes upon the present state of Foreign Field Artilleries.

The Minister at War, in order to facilitate this part of the instruction, supplies the information furnished by Foreign Military Attachés.

(*b.* Tactics.

1. Course of applied tactics with special reference to the employment of Field Artillery in action.
2. Account of remarkable historical facts relating to the employment of Artillery in action.

(*c.*) Farriery.

During the first period of the course the practical work consists of,—

1. Solution of problems with aid of Practice Tables.
2. Employment of range finders with a view to Field Service.
3. Examination of and execution of repairs to material, which should be done in Batteries.
4. Solution of tactical problems with aid of maps and of war games.

The second period is devoted to,—

1. Gun practice with field and mountain guns. This part of the instruction is the most important in the course.
2. Solution of tactical problems upon real ground.
3. Construction of Field entrenchments for Artillery.

Besides, the Officer Students visit certain Artillery establishments as follows:—they inspect the foundry, arsenal, and workshops of the Artillery Depôt of the District; they are present at experiments at the central Depôt at Okhta, when the Director of the School considers it useful; and in order to familiarize themselves with the combined operations of several Batteries, they attend some of the manœuvres of the Military District of St. Petersburgh, according to the selection of the Director.

The Professors and the Superintendent of the practical work are chosen by the Director, and receive appointments, borne upon the estimates for that branch of the Service; the Superior Officer or Subaltern of the permanent strength, have the privilege of being Professors at the School, or of directing the practical work, if the Director thinks them fit for this duty; in which case they receive an addition of pay.

Independently of what has been previously stated, the Officer Students are familiarized by practical exercises with the service of the Batteries of the School, with the administration and forms employed in the execution of manœuvres, with the instruction and education of the soldier, and, in general, with everything which, without being prescribed by the regulations in force, is admitted by experience. During the first period they go through a course of riding.

Examinations.

At the end of the course of study the Officer Students have to go through a practical examination upon all the subjects which have been taught them at the School. This examination consists principally in the solution of tactical problems upon ground, combined with gun practice at different objects. It takes place under the Presidency of of the Director of the School, in presence of a Commission named by the Minister-at-War. The marks given are the following;—"very good," "good," and "indifferent."

The Commission reports the result of the examination to the Minister at War, particularly directing his attention to the regular execution of the synopsis adopted. The Director of the School also sends a report of the examination to the "Grand Maître" of the Artillery.

Allowances—Maintenance of the School.

The Officers and functionaries of the permanent strength have a right to lodging allowance, or to quarters furnished by the State. In the latter case, they are allowed light and fuel; no reduction is made from the allowance when they are absent. The Officers of the permanent strength, charged with the superintendence of the instruction detachments, formed with a view of preparing the Feuerwerkers for the service of the School, receive the following allowances: Superior Officers 180 roubles, Subaltern Officers 120 roubles. During their stay at the School, the Officer Students have a right to lodging and table allowances, and to the additions allowed while in camp. Those who in their own Batteries had the right of Superior Officers' table allowances, preserve it during their stay at the School. During the journeys undertaken to visit the service establishments of Artillery and the central offices, the Superior and Subaltern Officers have the right of free travelling expenses, and a daily indemnity of two roubles. During the practical manœuvres in the country, the superior officers draw an allowance of two roubles, and Subaltern Officers of one rouble, independently of the camping allowances. When the Officers are in quarters, no stoppage is made from them.

At the end of the course the Officer Students receive a gratuity of four months' nett pay. To facilitate the study of repairs to Artillery material which fall upon Batteries, the Artillery Service delivers at the School a certain number of guns, carriages, limbers, &c., unfit for service, but still able to be utilized for the practical work of the School.

Horses.

The horses attached to the service of the School are bought by the Remount Officers of the Artillery of the Guard; they are dark-coloured, their quality and price are those of the riding or draught horses of the Artillery of the Guard.

Part of the riding horses, intended for the Officers of the variable strength, are recruited from cast horses coming from Cavalry and Troops of Horse Artillery.

Mobilization.

The Batteries attached to the School are mobilized according to special arrangements prescribed by the General Staff.

GERMANY.

I.

EXTRACTS FROM GERMAN NEWSPAPERS.

BY

LIEUT.-COLONEL G. T. PRETYMAN, R.A.

THE attempts which have of late been made towards lessening the loads of Cavalry horses in the various regiments, especially during the late manœuvres, have had a happy result, and as all reports have spoken so favourably about them, there would seem to be little doubt of the adoption of the proposed improvements throughout the whole German Cavalry.

The following changes are contemplated :—

It is intended to replace the hitherto heavy, cumbrous saddle by a lighter one, sufficiently durable, of improved construction.

The heavy, useless, and merely ornamental shabraques are to be entirely dropped.

The so-called parade halter (head-collar), which was worn with the bridoon and bit, will be replaced by a simple leather thong for fastening up horses in bivouac. The bridoon is to be abolished.

As a specially important change it is noted that the carbine, which now, as we know, is carried in a bucket at the horse's side, thereby encumbering and annoying both horse and rider as much as the present loose, banging-about sword does, will in future be slung on the man's back, in such a manner as not to incommode him at a fast gallop, while at the same time so easily got at as to be freed by a grip quicker even than he can now release it from the bucket.

On the other hand, the sword, which is only useful to a cavalryman so long as he is mounted, is to be carried forward on the right side of the horse, fastened on to the saddle in a practical way, and will remain there when the rider dismounts.

The dismounted man, who then is armed only with his carbine (a not-to-be-despised weapon) becomes for the nonce a lightly-weighted foot soldier, no longer encumbered as hitherto with a sword getting between his legs as he runs, &c.

Similarly, in view of the greater importance attached now-a-days to firearms, the cartridge-pouch, hitherto hanging at a man's back, is to be replaced by two pouches worn rather forward, one on each side, attached to the waist-belt or girdle.

The white leather-work of the present belts will entirely disappear, giving place to brown leather, which will not require so much polishing and cleaning.

The "cleaning traps," which hitherto every man has had to keep by him separately, will now be divided amongst four or five men, each carrying a portion only.

The heavy, hard, and almost useless short "reserve" boots (probably corresponding to our "ammunition" boots) will be replaced by easy, linen shoes.

The amount of iron-work generally, such as in pouches, horse shoes, &c., will be perceptibly diminished.

The "reserve" drill-hose will be abolished.

The prayer-books, which hitherto have been carried by every individual, will in future be distributed in a regulated number to each squadron.

By means of all these reforms, the total dead weight now carried by each troop horse (which comprises, moreover, the fixed ration now carried for man and horse) is also to be reduced by a quarter, a change which will be in the highest degree advantageous to the horse, whilst, at the same time, the rider will be equipped more sensibly and with greater comfort to himself.

Experiments of a very peculiar kind are being made just now in Munich, Mayence, and Munster, and elsewhere, with companies specially formed of the strong men of different regiments in the matter of subsistence or, more strictly speaking, of hunger!

The unfortunates selected are obliged to suffer patiently for a fortnight a strict campaigning diet, and during this period have to go through field exercises and route-marching for six hours daily in full marching order.

Before and after every march out, each man has to be carefully weighed, and his increase or decrease of weight noted.

During the time of trial each man receives daily a regulated quantity of a minutely-prescribed dietary; *e.g.*, in Mayence, biscuit, coffee, pea-sausages (*erbswurst*); in Munster, rye bread, brandy, and *erbswurst*; the Munich "*ménu*" has so far remained a secret.

The men are constantly and closely watched, so that it is impossible for anyone to obtain a morsel of any other food or drink than that laid down, and which is exactly weighed or measured out.

Even the evening interviews with the Privy Counsellor's cook or the Colonel's housemaid is interdicted; as these compassionate beings might attempt to convey secretly something more savoury than the ration prescribed in General Orders to their hungry warrior lovers.

The idea of this peculiar experiment is to determine how long the poor fellows can remain fit for work on such diet, besides which kind of the special food itself will longest sustain the normal condition of the body; or more clearly, how long the soldier will continue lusty and be able to perform all the duties required of him on such diet.

. . . .

It occurred to me that the above short extracts I happened to notice in a German newspaper might be of some interest to my brother Officers.

The Germans, as usual, are busy making experiments and working out practical details in their Army. The proposed changes in their cavalry equipment are not new ideas. Many of our more thoughtful Officers in the mounted branches have been for some time past on the same tracks. Indeed, on active service several of the German suggestions have actually been tested, and found to answer admirably.

It may be remembered by some that, in the Cavalry charge near Kabul on the 11th December, 1879, in which the 9th Lancers suffered somewhat severely, a number of carbines (over thirty if my memory serves me), were lost by us and captured by the Afghans, owing to the fact that, being carried as per regulation in the buckets on the saddles, the loose horses galloped away with them, leaving their wounded or unwounded riders with nothing but a nearly useless sword wherewith to defend themselves on foot, besides occasioning a serious loss of firearms to the regiment engaged. After this experience, it was found necessary to order all men in Cavalry Regiments to sling their carbines over their backs before coming in presence of the enemy; and now, I believe, some of the Indian Cavalry Regiments are equipped with an improved saddle gear, the sword being carried on the saddle, the carbine slung on the man's back. This would seem to be the sensible arrangement—in these days when Cavalry have frequently to act with carbines on foot. As to the shape or pattern of our present Cavalry sword I will not venture to offer an opinion, though, I believe, amongst experts a change is wished for. We heard something of the quality of the steel (?) from the Cavalry engaged against the Arabs on the Red Sea "*Litoral*" last year. With regard to the present steel scabbard, experience has frequently proved that it is worse than useless on active service: not only does it blunt the edge of the sword carried in it (and a sword without a really keen edge is not of much use), but the rattle and glitter it makes is a grave disadvantage in presence of an enemy.

It is earnestly to be hoped that we may not be behind the Germans in carrying out equally sensible reforms. The lightening of kits, &c., and of equipment generally, speaks for itself.

NOTES:

BY VARIOUS HANDS.

The R.A. Steeplechases are postponed from the 10th to the 11th of April.—*H.W.L.H.*

It is notified for the information of those concerned that the Photographic Album of 'L' Battery, 'B' Brigade, R.H.A., has been deposited here for the present by Captain Bannatine, who has gone to the Soudan.—*H.W.L.H.*

Several complaints have been lately received from Members about not receiving their "Proceedings," &c. In nearly all cases the non-arrival of their papers arose from their not notifying, as requested on the Seniority List, their change of address.—*H.W.L.H.*

Mr. Flinsch, of 40, Upper Thames Street, is introducing into this country a Transparent Waterproof Map Cover, which is used in both the German and Austrian Armies. A specimen has been forwarded to the Secretary of the Institution. The cover is expressly prepared to suit English maps, and is ruled on one side with one-inch squares, and on the other side with squares of 100 yards side for the scale of 6 ins. to the mile. The cover is $9\frac{1}{2}$ ins. × 6 ins. and strongly sewn, and provided with a glass to keep out wet. Colonel Lonsdale Hale, retired R.E., informs us that these covers have been used for some time at the Staff College and found excellent. As both sides of the cover are transparent, an Officer can move over a tract of country 19 miles × 12 miles without having to re-arrange the map in the cover, whilst the squares enables him to judge distances without any other aid. The price of the cover is 3s., and Herr Scroba of Metz, the manufacturer, has an assortment of various sizes, which can be obtained through the Secretary.—*H.W.L.H.*

ON THE USE OF

GENERAL TABLES

TO CALCULATE

TIMES OF FLIGHT AND REMAINING VELOCITIES.

BY

REV. F. BASHFORTH, B.D.,

Late Professor of Applied Mathematics to the Advanced Class of R.A. Officers.

COMMUNICATED BY

THE SECRETARY.

WHEN experiments were made with my Chronograph, in 1867–8, to determine the Resistance of the Air to the Motion of Projectiles, the 3-inch, the 7-inch, and the 9-inch Service M.L. guns were used. It afterwards appeared that these guns did not impart a high degree of steadiness to their projectiles. This defect caused undue resistance of the air, and gave high values to K the coefficient of resistance. I have elsewhere[1] shewn that with solid or cored shot, the,—

3-inch gun gave $K_{1280} = 117{\cdot}9$,

7-inch " " $K_{1300} = 114{\cdot}4$,

9-inch " " $K_{1280} = 118{\cdot}2$.

But these high numbers were fortunately much reduced by the superior performance of the 5-inch gun, which was made from a condemned B.L. gun. This gun was remarkable for its good shooting and gave so low a value as $99{\cdot}9$ for K_{1280}. The tabular value of K_{1280}

---

[1] *Nature*, April 3rd, 1884; *p.* 527.

finally adopted was 109·0. Hence it must be plain that no single set of General Tables can be formed to suit the shooting of all guns, be they good or bad. But it will be found to be a simple matter to apply corrections to existing Tables, so as to allow for the varying density of the air, for the degree of steadiness of the shot, and for different forms of heads of elongated shot. It must be remarked that the 5-inch gun did not maintain its superiority when fired with lower charges.

As we suppose that the resistance of the air to the motion of a projectile will vary as the *density* of the air, the coefficients K will all vary as the density of the air. The tabular values of K have been calculated on the supposition that a cubic foot of air weighs 534·22 grains. Then, on another day, the values of K will all be changed to τK, where τ is the weight of a cubic foot of air on that day in grains $\div$ 534·22. τ will therefore be a constant for that round, provided the shot does not rise high enough to have its motion sensibly affected by the rarefaction of the air. In the Table of values of τ the air is supposed to be two-thirds saturated with moisture.

According to the ordinary notation,—

$$\frac{d^2}{w}t = -(1000)^3 \int_{v_1}^{v_2} \frac{dv}{Kv^3}, \text{ where } K \text{ is a function of } v$$

$$= Tv_1 - Tv_2 = \text{the difference of two tabular numbers.}$$

But on the day above referred to, K must be replaced by τK,

and then $$\frac{d^2}{w}t = -(1000)^3 \int_{v_1}^{v_2} \frac{dv}{\tau K v^3} = -\frac{(1000)^3}{\tau} \int_{v_1}^{v^2} \frac{dv}{Kv^3},$$

or $$\tau \frac{d^2}{w}t = -(1000)^3 \int_{v_1}^{v_2} \frac{dv}{Kv^3} = T_{v_1} - T_{v_2}$$

$$= \text{the difference of the same tabular numbers as before.}$$

Suppose now a change to be made in the *form* of the head of the shot, and that for this particular form of head it is necessary to change the values of K obtained from experiments with ogival-headed shot of one diameter and a-half into κK, where κ is a constant.

Further, suppose that we are experimenting with a gun that gives a degree of *steadiness* to the shot different from that given by the experimental guns, so as to change all the coefficients K into σK, where σ is a constant. Just as before we shall have,—

$$\frac{d^2}{w}\tau\kappa\sigma t = T_{v_1} - T_{v_2} = \text{difference of the tabular numbers.}$$

and $$\frac{d^2}{w}\tau\kappa\sigma s = S_{v_1} - S_{v_2} = \quad " \quad " \quad " \quad "$$

In order to introduce these corrections into our calculations, we have only to find the numerical value of $\frac{d^2}{w}\tau\sigma\kappa$ for that particular round, and use that value instead of $\frac{d^2}{w}$ in calculating space and time by the help of the General Tables, and the same will apply to the calculation of trajectories.

It is fortunate that we have the particulars of three good rounds of both flat-headed and hemispherical-headed shot, fired in March, 1879.[1] From these experiments, values of K were derived for velocities 1520 to 1870 f.s., for *flat*-headed shot,[2] and also for velocities 1640 to 1880 f.s.[3] for *hemispherical*-headed shot. If now for any velocity v between the above limits we divide K_v for *flat*-headed shot by the tabular value K_v for ogival shot (1·5 d.), we obtain the value of the coefficient κ_2 for the velocity v, as given in the following Table. And in the same manner the value of κ_1 for hemispherical-headed shot, may be found, as given below.

κ_1 the coefficient for hemispherical-headed shot.

κ_2 " " flat-headed shot.

v	κ_1	κ_2	v	κ_1	κ_2	v	κ_1	κ_2	v	κ_1	κ_2
f.s.			f.s.			f.s.			f.s.		
1500	—	—	1600	—	1·94	1700	1·37	2·09	1800	1·39	2·19
1510	—	—	1610	—	1·96	1710	1·37	2·10	1810	1·38	2·20
1520	—	1·80	1620	—	1·98	1720	1·38	2·11	1820	1·38	2·21
1530	—	1·82	1630	—	1·99	1730	1·38	2·12	1830	1·37	2·21
1540	—	1·84	1640	1·33	2·01	1740	1·38	2·14	1840	1·37	2·22
1550	—	1·86	1650	1·34	2·02	1750	1·39	2·15	1850	1·36	2·23
1560	—	1·88	1660	1·35	2·04	1760	1·39	2·15	1860	1·35	2·23
1570	—	1·89	1670	1·35	2·05	1770	1·39	2·16	1870	1·35	2·24
1580	—	1·91	1680	1·36	2·07	1780	1·39	2·17	—	—	—
1590	—	1·93	1690	1·36	2·08	1790	1·39	2·18	—	—	—

Flat-headed shot. Rounds 464–6. Barometer 30·40 inch. Dry bulb, 42°. Wet bulb, 41°. This gives the weight of a cubic foot of air on the day of experiment, by the help of Glaisher's Tables, 561·2 grains, which being divided by 534·22 makes $\tau = 1{\cdot}051$. Or, if we use the accompanying table of values of τ, we find at once $\tau = 1{\cdot}038 + {\cdot}014 = 1{\cdot}052$. Also $d = 6$ ins., $w = 70$ lbs. The three shots passed the 3rd screen at 0″·1595, 0″·1603, and 0″·1606, giving a mean of 0″·16013; and the 9th screen at 0″·6863, 0″·6914, and 0″·6927, giving a mean of

[1] Final Report, *p.* 14. [2] *Ibid*, *p.* 43. [3] *Ibid*, *p.* 40.

$0''\cdot69013$; or, the mean time occupied in passing from the 3rd to the 9th screen was $0''\cdot5300$, and the distance between the screens was 6×150 feet $= 900$ feet. The 3rd screen was passed with a mean velocity of 1827·7 f.s., and the 9th screen with a mean velocity of 1585·0 f.s. Referring to the table of values of κ_2, we may suppose it to have a mean value 2·07 between velocities 1827·7 and 1585 f.s.

Then $\quad \dfrac{d^2}{w}\tau\kappa_2 = \dfrac{36}{70} \times 1\cdot052 \times 2\cdot07 = 1\cdot120,$

and $\quad \dfrac{d^2}{w}\tau\kappa_2 t = T_{1827\cdot7} - T_{1585\cdot0} = 233''\cdot1520 - 232''\cdot5583 = 0''\cdot5937,$

or $\quad t = \dfrac{0''\cdot5937}{1\cdot120} = 0''\cdot5301$, the calculated time; and that found by experiment was $0''\cdot5300$.

Next, we will calculate the distance v, in which the velocity of this flat-headed shot would be reduced from 1827·7 to 1585·0 f.s. :—

Here $\quad \dfrac{d^2}{w}\tau\kappa_2 s = S_{1827\cdot7} - S_{1585} = 44550\cdot8 - 43541\cdot1 = 1009\cdot7.$

Therefore $\quad s = \dfrac{1009\cdot7}{1\cdot120} = 901\cdot6$ feet instead of 900 feet.

Hemispherical-headed shot. Rounds 467–9. Barometer 30·25 in. Dry bulb, 45°. Wet bulb, 42°. Hence the weight of a cubic foot of air was 555·2 grains, and dividing by 534·22, we obtain $\tau = 1\cdot039$, or, referring to the table, we find at once $\tau = 1\cdot031 + 0\cdot008 = 1\cdot039$ as before. The mean times of passing the 3rd and 9th screens will be found to have been $0''\cdot15927$ and $0''\cdot6671$, giving the mean time of passing over the 900 feet between the 3rd and 9th screens $0''\cdot50783$. Also the mean velocities at the 3rd and 9th screens were 1856 and 1692 f.s. Between these limits of velocity we find from the above table that we may take $\kappa_1 = 1\cdot38$. Then,—

$$\frac{d^2}{w}\tau\kappa_1 = \frac{36}{70}\, 1\cdot039 \times 1\cdot38 = 0\cdot7374,$$

and $\quad \dfrac{d^2}{w}\tau\kappa_1 t = T_{1856} - T_{1692} = 233''\cdot2123 - 232''\cdot8383 = 0''\cdot3740;$

and therefore $\quad t = \dfrac{0''\cdot3740}{0\cdot7374} = 0''\cdot5072$, and the time given by experiment was $0''\cdot50783$.

We will now find the remaining velocity of the same shot starting with a velocity of 1856 f.s., after moving over 900 feet. We have,—

$S_v = S_{1856} - \dfrac{d^2}{w}\tau\kappa_1 s = 44661\cdot8 - 663\cdot6 = 43998\cdot2$, which gives $v = 1691\cdot7$ f.s., and that given by experiment was 1691·0 f.s.

The General Tables used to calculate the above examples were derived entirely from experiments made with ogival-headed shot (1·5 d.). But

the values of κ_1 and κ_2 were derived from the examples, which they were used to calculate. This will, in part, account for the close agreement between the experimental and calculated results. But in all other cases, the results of calculation will be just as good, provided only as good and reliable data are furnished to the calculator, and that the shot travels with ordinary steadiness.

From the experiments made in September, 1866, to determine the resistance of the air to variously formed heads of elongated shot, the following values K_{1400} were derived from rounds of ogival-headed shot of (1 d.) and (2 d.) fired alternately.

Round.	One Diameter.	Error.	Round.	Two Diameters.	Error.
14	108·6	+ 0·1	15	108·0	+ 4·6
16	113·1	+ 4·6	17	—	—
18	109·6	+ 1·1	19	—	—
20	108·0	− 0·5	21	103·5	+ 0·1
22	105·3	− 3·2	23	104·6	+ 1·2
24	110·1	+ 1·6	25	99·1	− 4·3
26	108·1	− 0·4	27	100·8	− 2·6
28	108·4	− 0·1	29	103·0	− 0·4
30	109·6	+ 1·1	31	104·0	+ 0·6
32	104·4	− 4·1	30	194·2	+ 0·8
	10)1085·2	16·8		8)827·2	14·6
Means ...	108·5	1·7	Means ...	103·4	1·8

We may therefore suppose that our tabular values of K derived from experiments with ogival-headed shot (1·5 d.) to fit them for the calculation of the motion of ogival-headed shot (2 d.) must be reduced in the proportion of $\kappa = \dfrac{100}{102{\cdot}5} = 0{\cdot}975$ nearly.

But the effect of *unsteadiness* is probably more important in its effects. We have seen that in a particular case $\sigma = \dfrac{99{\cdot}9}{109{\cdot}0} = 0{\cdot}9165$; but that superiority was not maintained by the 5-inch gun at lower velocities. In the absence of trustworthy experiments, I am unable to fix upon any value of σ to suit the average steadiness now attained in shooting with large guns. Perhaps it would suffice to make $\sigma = 0{\cdot}975$ for velocities 900 to 1700 f.s. corresponding to the limits of the early experiments, and 1 beyond that limit. But κ would be 0·975 throughout to adapt the results for ogival-headed shot (1·5 d.) to those for (2 d.). The values of σ and κ used ought to be specified in all cases.

As the coefficient of resistance is known to be a varying quantity, experiments made with a view to discover its values at different velocities should be carried out with moderate ranges, so as to allow the velocities to be measured at both ends with certainty. In each case the mean of five good experiments should be taken. Afterwards the value of the results might be further tested by applying them to calculate Range Tables corresponding to those given by experiment, where both the initial velocity and the initial direction of the shot were accurately known. I have done this for low velocities, and given the results at pp. 44–49 of "Final Report."

Correction τ of K for Temperature and Pressure of Atmosphere two-thirds saturated with moisture.

F.	26 in.	27 in.	28 in.	29 in.	30 in.	31 in.	Δ +	F.	26 in.	27 in.	28 in.	29 in.	30 in.	31 in.	Δ +
°								°							
0	·983	1·021	1·059	1·097	1·134	1·172	38	50	·884	·919	·953	·987	1·021	1·055	34
1	·981	1·019	1·056	1·094	1·132	1·170	38	51	·883	·917	·951	·985	1·019	1·053	34
2	·979	1·017	1·054	1·092	1·130	1·167	38	52	·881	·915	·949	·983	1·017	1·051	34
3	·977	1·015	1·052	1·090	1·127	1·165	38	53	·879	·913	·947	·981	1·015	1·048	34
4	·975	1·012	1·050	1·087	1·125	1·162	38	54	·877	·911	·945	·978	1·012	1·046	34
5	·973	1·010	1·047	1·085	1·122	1·160	37	55	·875	·909	·943	·976	1·010	1·044	34
6	·971	1·008	1·045	1·083	1·120	1·157	37	56	·874	·907	·941	·974	1·008	1·042	34
7	·969	1·006	1·043	1·080	1·118	1·155	37	57	·872	·905	·939	·972	1·006	1·039	34
8	·966	1·004	1·041	1·078	1·115	1·152	37	58	·870	·904	·937	·970	1·004	1·037	34
9	·964	1·001	1·039	1·076	1·113	1·150	37	59	·868	·902	·935	·968	1·002	1·035	33
10	·962	·999	1·036	1·073	1·110	1·147	37	60	·866	·900	·933	·966	1·000	1·033	33
11	·960	·997	1·034	1·071	1·108	1·145	37	61	·865	·898	·931	·964	·998	1·031	33
12	·958	·995	1·032	1·069	1·105	1·142	37	62	·863	·896	·929	·962	·996	1·029	33
13	·956	·993	1·029	1·066	1·103	1·140	37	63	·861	·894	·927	·960	·993	1·027	33
14	·954	·991	1·027	1·064	1·101	1·137	37	64	·859	·892	·925	·958	·991	1·024	33
15	·952	·989	1·025	1·062	1·098	1·135	37	65	·857	·890	·923	·956	·989	1·022	33
16	·950	·986	1·023	1·060	1·096	1·133	37	66	·856	·889	·921	·954	·987	1·020	33
17	·948	·984	1·021	1·057	1·094	1·130	37	67	·854	·887	·919	·952	·985	1·018	33
18	·946	·982	1·019	1·055	1·091	1·128	36	68	·852	·885	·918	·950	·983	1·016	33
19	·944	·980	1·017	1·053	1·089	1·125	36	69	·850	·883	·916	·949	·981	1·014	33
20	·942	·978	1·014	1·051	1·087	1·123	36	70	·849	·881	·914	·946	·979	1·012	33
21	·940	·976	1·012	1·048	1·084	1·121	36	71	·847	·879	·912	·944	·977	1·010	33
22	·938	·974	1·010	1·046	1·082	1·118	36	72	·845	·878	·910	·943	·975	1·008	33
23	·936	·972	1·008	1·044	1·080	1·116	36	73	·843	·876	·908	·941	·973	1·006	32
24	·934	·970	1·006	1·042	1·078	1·114	36	74	·842	·874	·906	·939	·971	1·004	32
25	·932	·968	1·004	1·039	1·075	1·111	36	75	·840	·872	·904	·937	·969	1·001	32
26	·930	·966	1·001	1·037	1·073	1·109	36	76	·838	·870	·902	·935	·967	·999	32
27	·928	·964	·999	1·035	1·071	1·106	36	77	·836	·868	·901	·933	·965	·997	32
28	·926	·962	·997	1·033	1·069	1·104	36	78	·834	·867	·899	·931	·963	·995	32
29	·924	·960	·995	1·031	1·066	1·102	36	79	·833	·865	·897	·929	·961	·993	32
30	·922	·958	·993	1·028	1·064	1·099	36	80	·831	·863	·895	·927	·959	·991	32
31	·920	·956	·991	1·026	1·062	1·097	35	81	·829	·861	·893	·925	·957	·989	32
32	·918	·954	·989	1·024	1·059	1·095	35	82	·827	·859	·891	·923	·955	·987	32
33	·916	·952	·987	1·022	1·057	1·093	35	83	·826	·858	·889	·921	·953	·985	32
34	·914	·950	·985	1·020	1·055	1·090	35	84	·824	·856	·887	·919	·951	·983	32
35	·913	·948	·983	1·018	1·053	1·088	35	85	·822	·854	·885	·917	·949	·980	32
36	·911	·946	·981	1·016	1·051	1·086	35	86	·821	·852	·884	·915	·947	·978	32
37	·909	·944	·979	1·013	1·048	1·083	35	87	·819	·850	·882	·913	·945	·976	32
38	·907	·942	·977	1·011	1·046	1·081	35	88	·817	·848	·880	·911	·943	·974	31
39	·905	·940	·974	1·009	1·044	1·079	35	89	·815	·847	·878	·909	·941	·972	31
40	·903	·938	·973	1·007	1·042	1·077	35	90	·814	·845	·876	·908	·939	·970	31
41	·901	·936	·971	1·005	1·040	1·075	35	91	·812	·843	·874	·905	·937	·968	31
42	·899	·934	·968	1·003	1·038	1·072	35	92	·810	·841	·872	·903	·935	·966	31
43	·898	·932	·967	1·001	1·036	1·070	35	93	·808	·839	·870	·902	·933	·964	31
44	·896	·930	·964	·999	1·033	1·068	34	94	·806	·837	·868	·900	·931	·962	31
45	·894	·928	·963	·997	1·031	1·066	34	95	·805	·836	·867	·898	·929	·960	31
46	·892	·926	·960	·995	1·029	1·063	34	96	·803	·834	·865	·896	·926	·957	31
47	·890	·924	·958	·993	1·027	1·061	34	97	·801	·832	·863	·893	·924	·955	31
48	·888	·923	·957	·991	1·025	1·059	34	98	·799	·830	·861	·891	·922	·953	31
49	·886	·920	·955	·989	1·023	1·057	34	99	·797	·828	·859	·889	·920	·951	31
50	·884	·919	·953	·987	1·021	1·055	34	100	·796	·826	·857	·888	·918	·949	31

NOTE.—The following experiments have been forwarded to me, but without any particulars, to show that my General Table does not give results corresponding with the results of experiments made with recent guns. As the ranges given are 2000 and 3000 metres, I conclude that the experiments are of foreign origin.

I have calculated the remaining velocities by my General Table (1879) making $\sigma\kappa = 0{\cdot}907$. I have also converted the English into French measures, calculated the remaining velocities by the "*Table de Krupp*," and finally stated the results in feet per second for comparison. But I cannot attach any importance to the experiments themselves.

Results of Experiment.					Results of Calculation.			
d.	*w.*	*s.*	Muzzle Velocity.	Remaining Velocity.	Bashforth $\sigma\kappa = 0{\cdot}907$ Remaining Velocity.	Error.	Krupp Remaining Velocity.	Error.
ins.	lbs.	feet.	f.s.	f.s.	f.s.		f.s.	
5·9	112·5	6561	1710	1296	1310·1	+ 14·1	1313·0	+ 17·0
10·236	451	"	2024	1679	1671·0	− 8·0	1657·2	− 21·8
11·024	760	"	1748	1520	1526·0	+ 6·0	1523·7	+ 3·7
12·01	1003	"	1532	1364·5	1351·5	− 13·0	1355·3	− 9·2
"	"	9843	1558	1293·5	1292·6	− 0·9	1298·3	+ 4·8

I have also re-calculated the remaining horizontal velocities of the experiments given in the "*Annexe à la Table de Krupp*" by my General Table (1879) (84/B/2853) making, as above, $\kappa\sigma = 0{\cdot}907$. I have also taken the trouble to re-calculate them by the "*Table de Krupp*," to satisfy myself that we were employing the same data. For the most part the agreement in the results was exact, and in other cases the difference was hardly worth mentioning, excepting rounds numbered 21 and 27, while rounds 29 and 30 were quite erroneous.

On comparing the two sets of calculated remaining horizontal velocities, it will be found that the chief discrepancies are in rounds numbered 20 to 24 and 33 to 37. This arises from the excessive reductions M. Krupp has been pleased to make in my resistances for velocities about 1100 f.s., or 335 m.s. I find that reductions in the "*Table de Krupp*" have been made for velocities 600, 700, 800, 900, 1000, 1100, 1200, 1300, 1400 f.s., &c., at the rate of 15, 10, 3, 11, 11, 28, 16, 12, 10, &c., per cent. This reduction of 28 per cent. is simply erroneous, as will be found on trial. The first experiment with my Chronograph was carried out by firing several rounds of Service shot from a 12-pr. B.L. gun. The form of the head of the shot approached

about the perfect accuracy of these results, the means of *eleven* good rounds:—

Distance from gun.		Velocity by Experiment.	Velocity "*Table de Krupp.*"
130 feet.		1149·4 f.s.	1149·4 f.s.
930 "		1067·8 "	1090·9 "
Loss of velocity in 800 feet	...	81·6	58·5

Shewing a very striking error in the result given by the "*Table de Krupp*" in the short range of 244 metres. No probable degree of unsteadiness could account for this. How, then, is it that a Table, which fails so remarkably in a short range of 244 metres, gives results in accordance with experiment for ranges of 4446 and 5945 metres? The Tables being manifestly wrong, what becomes of the experiment?

I object to M. Krupp's method of experimenting with ranges of 2000, 3000, and even up to 5945 metres, because a long range involves considerable curvature in the trajectory, and increases the difficulty of obtaining *accurate* measures of the velocity, by reason of the inclination of the trajectory to the horizon at both extremities, where the screens have to be placed. And it is for M. Krupp to show how his Table has been constructed, and that it can be accurately applied to calculate the remaining horizontal velocity where the trajectory is much curved.

I wish to guard myself from being supposed to accept the above experiments as accurate and conclusive. I have merely taken $\kappa\sigma = 0{\cdot}907$ to show how easily results similar to those given by the "*Table de Krupp*" may be obtained from my General Table, but I am not in position to say more than that it appears to me this reduction exceeds what careful experiment with long ranges will sanction, even when the best of modern guns are used.

In order to reduce my values of K to the standard of density of the air adopted by M. Krupp, it would be necessary to multiply all of them by 0·987, or to reduce them 1·3 per cent. This would have no effect on the results of calculation, when proper corrections were made for the density of the air on the days of experiments.

The use of ogival-headed shot struck with a radius of 2 diameters, instead of one struck with a radius of $1\frac{1}{2}$ diameter, employed in the original experiments, would require a correction $\kappa = 0{\cdot}975$, giving a reduction of about $2\frac{1}{2}$ per cent. in the values of K.

In the above calculations we have used a value 0·907 of $K\sigma$, which gives $\sigma = 0{\cdot}930$, or an allowance of 7 per cent. is there made for the increased steadiness of modern projectiles over those of 1867–8.

CARNOT'S SYSTEM OF VERTICAL FIRE

CONSIDERED WITH RELATION TO

MODERN GUNNERY.

BY

LIEUT.-COLONEL W. R. BARLOW, R.A.

PERHAPS no scheme brought forward with great confidence, by a man of talent, ever failed more signally than Carnot's System of Vertical Fire. Carnot was no mere theorist, but a trained Engineer. His genius for organization was great, and he had well earned his title of the "Organiser of Victory." An ardent Republican, he left France when Napoleon became Emperor, but returned when he saw that his country must stand or fall with the Empire. So convinced was he of the undoubted value of his scheme, that for a considerable time he did not disclose it, as he feared that it would be useful to the enemies of France. When, however, the situation was changed, and France had to stand on the defensive, he published his carefully elaborated plans.[1]

In his work on the defence of Fortresses he is amusingly confident, and thus sums up the result of his plan of defence :—

"De l'écrit qu'on vient de lire, résulte je crois bien evidemment, cette vérité tranquillisante, c'est que les barrières de l'Empire Français sont absolument inexpugnables, pour quelque puissance ou réunion de puissances que ce soit, si elles sont bien défendues; c'est qu'une bonne garnison établie dans l'une de nos places actuelles, et animée du noble désir de s'illustrer par une défense mémorable, peut aussi longtemps qu'elle le trouvera pourvue de subsistances et de munitions, tenir tête a une armée dix fois aussi nombreuse, et se promettre enfin de la faire échouer, et même de la détruire entièrement, si celle-ci s'obstinait a vouloir surmonter la résistance."

It is necessary to say a few words about the old system of sieges which Carnot was opposing. The attack was so much stronger than the defence, that it had almost become an axiom that a place should fall after a certain number of days; so many days to circumvallation;

---

[1] Carnot "De la défense des places fortes."

opening the trenches; 1st, 2nd and 3rd parallel; crowning the glacis; breaching the escarp. In all, the best authorities pointed to about 30 days as the correct time for a siege; and then the garrison, having played their part of the recognised game, were allowed to march out with the honours of war: drums beating, colours flying, and nobody very much the worse. In fact, the system was much the same as in the time of the Grande Monarque, when the regularity of a siege was so great that the Court could leave Versailles at a fixed date, and arrive in state just in time to grace with their presence the last scene of the drama.

Naturally, Napoleon objected strongly to the governors of his fortresses holding such a weak idea of their duties; and Carnot, no doubt, was inspired in quoting the rigorous decrees by which the punishment of death was denounced against any Commandant surrendering his fort without sustaining an assault.

In order to illustrate their decrees, Carnot cites cases where Commandants had been executed for failing to carry them out. He points out that the main cause of the weakness of the defence was its being passive, and that an active defence alone could be prolonged, and even, in many cases, made altogether successful. He demonstrates the common error of turning all the defender's efforts to replying to the besieger's Artillery in the early part of the siege: as it was a certainty that the guns of the defenders would be overwhelmed by the superior fire of the attack, quickly dismounted and destroyed by enfilade fire, to which all the older class of forts were exposed.

He held that the fire of the fort should at first be sparingly used, the object being to prevent the attack being made with too much ease, just sufficient fire being kept up from time to time to annoy the enemy. The gist of the new system is thus given by him in his "*Discours préliminaires*" :—

"From the moment the besieger has established his Batteries, there should no longer appear on the ramparts a single man, nor a single gun; all should be withdrawn into casemates or blindages, whence the besieged should content himself by a ricochet fire along the trenches, and the capitals, waiting till the enemy should come within range of his small mortars in casemates (*pièrriers casematés*), that is to say, on the glacis of the place; then if the enemy presents himself in force, the besieged should open fire with all his mortars and overwhelm him with projectiles, whilst the shots of the besieger would be unable to hit anyone in the fort, except by some unforeseen accident. If, on the other hand, the besieger should limit himself to pushing on the heads of the saps, employing only a few workers, a number of small detachments should be formed, who should sally out suddenly, while the fire of the mortars was suspended, march rapidly to the heads of the sap, kill the workers, level the trenches, and return before the enemy (who under the supposed system, has retired out of the range of the vertical fire) is able to come to their rescue."

A detailed account of the proposed use of vertical fire is given on page 314 of Carnot's work; the main points are as follows:—

"Vertical fire is not to be used till the establishment of the 3rd parallel, since its effects at a longer range would be too uncertain, from this to the opening of the breach about 10 days will elapse.

"The 3rd parallel will be about 50 *toises* from the flanked angles of the bastions and from the demi-lune (a toise is about 2 yards). The besieger will occupy a space of $180 \times 50 = 9,000$ square toises, or say 15000 square toises in order to calculate the minimum effect.

"It is necessary to know how much of the 15,000 toises will actually be covered by the bodies of the besiegers. It is generally assumed that the number of the workmen and guards of the trenches should be at least three-quarters of the garrison, as they must be ready to repel a sortie of the garrison in force. Say that the garrison is 4,000 men, then at least 3,000 men must occupy the 15,000 square toises, *i.e.*, 1 man to 5 square toises; assume that a man occupies a square foot, then 36 men will occupy 1 square toise without any interstices. As there is 1 man to every 5 square toises, he will cover 1 square foot in 180 square feet, hence $\frac{1}{180}$ of the space occupied by the enemy will be actually covered with men. From this it follows that 1 shot out of 180 should hit the enemy in a long series of discharges; this is the minimum effect that vertical fire can produce, as the least favourable conditions for vertical fire have been assumed. For example, it has been assumed that the besieger is uniformly scattered over the whole space, much of which however is occupied by the ditches, where the enemy has not yet arrived; he is concentrated on the glacis, where it is easy also to concentrate the vertical fire; this nearly doubles the effect, especially by directing the fire on the capitals, where the enemy is strongest. Also a man when working or walking really covers more than a square foot; moreover, the ball falls at an angle approaching 45°, and at this angle a man presents a surface more than double his horizontal projection. Clearly, then, the effect of vertical fire is much greater than we have assumed; and even if we assume that 1 ball in 50 strikes, we shall still be under the mark; however, to avoid specious objections, we will keep to the first assumption that 1 ball in 180 strikes an enemy.

"Suppose, then, 6–12-inch mortars placed on the demi-lune and ramparts of the two bastions attacked, so as to bear on the capitals, since the enemy will there be in most force. The mortars will be well covered by blindages, only leaving the necessary space for the projectile at an angle of 45°, thus making them secure against direct and ricochet fire.

"The 12-inch mortar, throwing a shell of 150 lbs., can fire an equal weight of iron balls of $\frac{1}{4}$ lb. each, or 600 balls at each discharge; the 6 mortars firing 3600 at each discharge, taking $\frac{3600}{180} = 20$ as effective, each discharge will put 20 of the enemy *hors de combat*. Now, say that each mortar fires 100 rounds a day, then 2,000 of the enemy will be *hors de combat*, and in the 10 days up to the attack of the breaches, 20,000 men.

"Thus, if a garrison of 4,000 men is attacked by 20,000 men, all the besiegers will be destroyed before reaching the breaches.

"If the garrison were stronger, the loss of the enemy would be pro-

portionate; thus a garrison of 10,000 men would destroy 50,000 men by vertical fire alone, not reckoning those injured by other causes."

From the above, Carnot concludes that it is impossible to take even a small place defended by vertical fire, unless some new mode of attack is introduced.

In addition, Carnot points out that small mortars may be used, at short ranges, with small charges of powder, giving little recoil, easily worked, and the pieces being little strained; also musketry fire at 45° can be used.

The expense in men and money is small, little powder is used, and cast-iron balls will answer, or, at a pinch, iron rods cut up in lengths of an inch, will serve as *mitraille* for mortars; and in every town smiths will have plenty of iron; for large mortars the pavements of the streets will answer.

It is unnecessary to pursue further the advantages which Carnot claims for vertical fire. Enough has been said to prove that if Carnot's assumptions are true, the result of this class of fire is overwhelming. We must now briefly consider the rock on which his system splits. Curiously enough, this had been pointed out to Carnot, and he put it on one side.[1]

Briefly, the system may be condemned on this ground; the velocity of the falling body is too small to disable a man, unless the projectiles are made so heavy as to throw away the value of system. No one will deny that a 150 lb. ball falling a few feet would crack the thickest skull, but the 4-oz. weight is not sufficiently heavy, much less the musket balls, which Carnot also assumes would be effective. As a guide, it is well to remember that an ounce ball should have a velocity approaching to 500 feet a second to be deadly; while a ball falling 1000 feet has only about 250 feet velocity, even if we neglect the resistance of the air.

The whole system will be found carefully considered by Sir Howard Douglas' "Observations on Modern System of Fortifications," where it is pointed out that if mortars were fired at the short ranges given by Carnot, the charges of powder must be so small, that the projectiles would do little more execution than if thrown by hand; while if fixed at any elevation, the terminal velocity would be only 203 feet for a cast-iron ball of 4-ozs., taking into consideration the resistance of the air. The following experiment sufficiently demonstrated the impotence of the 4-oz. ball:—

A Coehorn mortar was placed 100 yards from six new deal targets laid on the ground, and two new wadmiltilts spread out near them, to estimate by the impression made on them the force with which the balls would fall. Loose balls were then put in over a wooden bottom. After a number of rounds with the above charge and elevation, with different numbers of 4-oz. balls, it was ascertained that the Coehorn would throw 42 of them 100 yards, and that the spread was, on the

[1] See page 528.

average, about 10 or 12 yards. It was not very easy to hit the targets and cloths, although they covered a surface of 774 feet; but in one instance 22 balls left their marks. The indentation on the surface of the deal was so small that it could not well be measured—it certainly was not more than $\frac{1}{20}$ of an inch deep. A ball thrown with force from the hand appeared to make an equal impression. Those which struck the wadmiltilt did not penetrate, but merely indented the ground underneath. The penetration of the balls into the ground (which was of the softest nature of meadow) was, on an average, 2 inches; but the balls thrown by hand did not penetrate so far.

The mortar was then elevated to 75°; with two ounces of powder and 42 balls made nearly the range as before; but the spread was increased to about 40 yards, so that it was difficult to hit the surfaces aimed at. Several balls did, however, at length fall on the targets and wadmiltilts. The impression on the former was something increased, but still so trifling as hardly to be measured; the balls did not go through the cloth, and the penetration on the meadow was only increased to about three inches.

It is unnecessary to add anything more; readers interested in the subject may well look at Carnot's and Sir H. Douglas' books; both are very interesting, and are certainly so well written, that even now it is a pleasure to read them, though of course modern gunnery has deprived them of much of their value.

Now I wish briefly to state how far modern conditions of gunnery have improved vertical fire, and how far we can now get over the cause which completely overturned Carnot's theory.

His calculation I think may be allowed to stand; and we may fairly assume the great value of vertical fire, if only the projectile can be given a sufficient descending velocity. Is it possible to give an ounce ball sufficient descending velocity when fired at an angle of 45° or upwards? I have no doubt that it is now possible. We can fire elongated steel shrapnel shell with a large bursting charge in rear, sufficient to give a velocity of about 300 feet a second, independent of the falling velocity, thus enabling us to get a velocity of nearly 500 feet a second; this will certainly suffice to put a man *hors de combat;* and I believe that the great advantage of Carnot's system can yet be reaped. If it is true that the advantages once justly claimed for the attack disappear, overhead cover would become necessary, and at the same time almost impossible, as a few steel common shell with large bursting charges would destroy it.

No experiment would be more instructive than conducting an attack against an earthwork defended by 6·3 and 6·6-in. howitzers, mounted so as to fire at any angle of elevation, and having steel common and shrapnel shell, the latter fuzed with accurate metal time fuzes, and the former with percussion fuzes with a delay-action. To the Royal Engineers, such an experiment appears to be of vital importance, and of the greatest interest to every garrison gunner.

But I am far from thinking that the efficacy of vertical and high-angle fire ends here; and I wish to point out that its importance is equally great with Field Artillery. Here I confess to broaching the

subject with some trepidation, as I fear that my views may be considered heretical and out of date by the modern school. Indeed, we have left Carnot and his errors so far behind, that it now appears to be an insult to attempt to kill a man by a projectile having a velocity of much less than 2000 feet a second. I am inclined to think it is a waste of power to use means so excessive for the object in view. High velocities mean high charges, heavy wear and tear of gun and carriage, especially the latter, which must have mechanical means, more or less costly, and more or less difficult to repair, to meet the excessive recoil. I for one would plead the necessity of introducing a powerful shell gun for field use, which should have great accuracy, moderate charges, steel shell, the common with heavy bursting charges, while the velocity should be sufficient to give effect to ounce balls, or thereabouts, in shrapnel shell up to ranges of 3,500 yards. I cannot but believe that for some time at least effective Artillery fire in the field will be limited by the distance at which the eye, unaided by a telescope, can judge of the effects of the fire; and I also think that at such ranges, a gun with moderate velocity will make shrapnel effective, and that any one hit by an ounce ball, even at a long range, will be inclined to say of his wound—"'Tis not so deep as a well, nor as wide as a church door, but it will suffice."

It is well to remember that in every campaign, villages have to be attacked, earthworks destroyed, and a number of objects attained, which can best be accomplished by heavy shell having large bursting charges; for this a shell gun is desirable.

The tendency to use cover is daily increasing: the wonderful efficacy of shelter-trenches was shown in the American War. Space forbids me to go into this subject, it will be found in sufficient detail in Brialmont's "*Fortifications sur le Champ de Bataille.*" He mentions the use made of shelter-trenches in the American War, when a simple trench was found to offer a most serious obstacle to a front attack; again, at Gravelotte, slight earthworks were found most useful. Bourbaki's Army was easily checked by Werner, who used earthworks freely; while the extemporised position at Plevna was made completely impregnable in a few days.

A high velocity gun firing shrapnel with a small angle of descent will effect little against a good type of shelter-trench, when high-angle fire would be most effective; any endeavour to gain cover by lying down would be a fatal error when exposed to high-angle fire as, of course, by doing so a larger surface would be exposed; troops in deep trenches, even of the profile used at Plevna, could be reached. Against supports in masses this class of fire would be effective, as they could be reached behind hills or in a ravine, where they would be safe from ordinary fire.

Clearly the best position for shell guns would be well in the rear of the line of Infantry; they should rarely change their position, and every effort should be made by scouts to ascertain the direction of the enemy's reserve. The necessity of having Infantry supports well in advance of the guns is now recognised; if the enemy's skirmishers come within 600 yards of the Battery, its position will be severely

compromised, hence it is desirable that the Infantry supporting the guns should be pushed well in advance of them.

This question is also discussed in Brialmont; and I think a careful perusal of his work will show that guns will have to act more than ever against troops under cover. That most daring of Generals, Skovilloff, has left on record his opinion of the necessity for using the spade, not only when on the defensive, but also when attacking; and it appears to me that Artillery tactics must be modified to meet this phase of warfare. No doubt high velocity guns may be fired with low charges so as to give high angles of descent, but then there is greatly diminished shell power, and undesirable complication of range-tables and ammunition.

There is little doubt that a howitzer of 6-inch calibre or thereabouts, weighing under 40 cwt., including its carriage, could be constructed, with a moderate charge of less than 10 lbs.; shrapnel would be effective up to between 3500 and 4000 yards. A steel shell would hold between 200 and 300 2-oz. balls, and at long ranges its angle of descent would be great enough to search any ordinary shelter-trenches; it would probably be advisable also to carry a proportion of shrapnel with a diminished number of balls and heavy bursting charges, when it may be necessary to search neighbouring ground with a plunging fire. In this case the velocity of the projectile would not be sufficient, without the additional impetus due to the bursting charge. No doubt the number of rounds carried would be limited by their weight; but the effect of a single successful round would be enormous. A gun of this nature should never be fired at random; range-finders should be used as much as possible; when acting on the defensive they can always be used, and even when attacking, in many cases ranges can be measured. Once the range was ascertained it would be impossible for troops in any close formation to sustain a high-angle fire from howitzers of large calibre; shelter-trenches would be useless to resist its plunging fire. Troops could be reached on the reverse slopes of hills and in ravines; lying down would be worse than useless.

It is tempting to consider the effect of 10 rounds on a Battalion in Column, say the ground covered is 5000 square feet, and that the shell contains 250 balls, taking a man to occupy a square foot, out of the 5000 square feet, 1000 will be covered by men, so $\frac{1}{5}$ of the balls should be effective in a successful round, this would mean 500 men hit in 10 rounds.

This is no doubt too much to expect, but it would be fair to say that 20 rounds would destroy half the Battalion.

As fire from a howitzer of the nature indicated would be accurate and effective up to about 2 miles, it would be difficult for the enemy to avoid exposing his troops in masses, though he might obtain cover from a gun with a low trajectory.

Much more might be said, but I hope some Officers of greater experience than myself, may be induced fully to consider the question, which is certainly an important one.

THE

MANŒUVRES

OF THE 7TH AND 8TH

GERMAN ARMY CORPS.

(September, 1884.)

BY

LIEUTENANT G. OSBORN, R.A.

In comparing the strength of the 7th Army Corps with that of 1870, one finds it is stronger now by three battalions (one regiment) of Infantry. There were five squadrons in a regiment on the manœuvre field, four in the war. The detail of the 7th Corps is here set forth:—

VII. GERMAN ARMY CORPS.

General Commanding: Lieut.-General von Witzendorf.

13th Division.

25 Infantry Brigade	No. 13 ...	1st Westphalian.
	" 53 ...	5th "
	" 15 ...	2nd "
26 Infantry Brigade	No. 55 ...	6th "
	" 131 ...	Infantry Regiment.

14th Division.

27 Infantry Brigade	No. 16 ...	6th Westphalian.
	" 39 ...	Nieder Rhein.
27 Infantry Brigade	No. 56 ...	7th Westphalian.
	" 57 ...	8th "
	Combined Regiments	7th Westphalian Yäger.
		7th " Pioneer.
13 Cavalry Brigade	No. 4 ...	Westphalian Cuirassier.
	" 8 ...	1st Westphalian Hussars.
14 Cavalry Brigade	No. 11 ...	2nd Westphalian Hussars.
	" 5 ...	Westphalian Uhlan.
1 Westphalian Field Artillery Regiment, No. 7 ...	1 Division	3 Batteries Field Artillery.
	2 Division	3 " " "
	Horse Artillery, 8 Batteries. (6 guns per Battery.)	
2 Westphalian Field Artillery Regiment, No. 22 ...	1 Division	4 Batteries Field Artillery.
	2 Division	4 " " "

The 8th Corps consists of the 15th and 16th Divisions, and about a similar strength of Cavalry and Artillery as the 7th.

The strength of the Battalions being 550, and of the squadrons 112, the two Corps together numbered 40,000 men with 148 guns.

Before entering upon an account of the manœuvres themselves, several things may first be noticed with advantage.

The manœuvre "Terrain" was mostly a gently undulating country, some of the hills around the Erft rising more abruptly to 200 feet or so above the stream. It was open and cultivated as last year, and consisted of stubble and root crops. The position of most of the villages was easily recognisable by clumps of trees in and around them, and often a church spire rising above.

The weather was bright and sunny, almost too hot, consequently the distance rather hazy. All the troops wore puggrees on their helmets—at least they must be dignified by the name, although a British soldier in India would laugh at the idea. The German climate only necessitates a puggree consisting of a round piece of white linen, about five inches in diameter, with a hole in the middle through which the spike of his helmet protrudes; this serves to keep the sun from glancing on the polished surface.

The German soldiers have a great advantage over our men in the following way:—they are accustomed to being billeted in villages and towns, and they thus have much intercourse with civilians, to whom they behave with the greatest politeness, and by whom they are looked up to, and most kindly treated. People having also sons and relations in the army hope they may also receive good treatment. This gives the soldiers a higher standard of morality, and increases their self-respect and the respect of the people towards them, and is to some extent the secret of their splendid behaviour in an enemy's country in 1870–71. They were billeted as usual this year during the manœuvre season, and bivouacked during the chief manœuvres beginning on the 15th.

In watching the recruits at Düsseldorf, at rifle drill, one obtained a hint how one might enable them to teach themselves, instead of the instructor continually hammering away, and often greatly confusing them by his lengthy explanation of the different positions. The instructor placed himself in front of the men, his back to them, and went through an exercise—the recruits trying to copy him independently—he, looking round after performing the motions several times, and thus seeing how the men were getting on.

In speaking of German Autumn Manœuvres it must not be supposed that they merely last for the short time the foreign officers are there; on the contrary, the men, having been thoroughly trained on the drill ground in personal efficiency, and moving in small bodies, then go through a long course of manœuvring in ever-increasing bodies, and against the various Arms in open and close country, and when working with all Arms in various proportions and numbers, they thus become familiar with well nigh every possible form of tactic, and their officers gain great experience.

On the 12th September, the 7th Corps held the last of such

manœuvres, when they assembled together for the first time during this year, and the two Divisions of which the Corps consists, fought a pitched battle near the heights of St. Leonard's.

15th September.—On the 15th commenced the series of grand manœuvres of the 7th against the 8th Army Corps.

The general idea on this day was that an Army was advancing from the north and north-west towards Cologne, and encountered an army covering that city near Bedburg.

The Infantry and Artillery of the 7th Army Corps assembled by 9 a.m. near Gustorf,—Girdorf. The Cavalry Brigade being stationed in a very sheltered spot between Morken and Konigshofen. The 8th Corps assembled nearly due south of this near the Bergheim-Julich road.

Some may take warning from the following experience:—A man who put himself down on the books at the hotel at Düsselsdorf, where I was stopping, as an English Officer, said that excellent information of the manœuvres was being sent to him, and if we rode together we should see all! I need only say the impostor got away with money he had borrowed from me! I had to ride sixty miles the next day in order to see anything of the manœuvres, and, worse than all, the fellow had my card and borrowed money of others in my name! However, having got to the scene of action at 10 a.m., better luck attended me. I rode to the most elevated ground, and found Prince William waiting at the summit. Scarcely arrived there, one saw from the Heights, south of Konigshofen, one or two horsemen trotting swiftly over the plain from the Cavalry Brigade (near Morkem) southwards towards Harff and Caster and over the hill towards Kirch-Herten, these single horsemen were quickly followed by others a little in rear, then small patrols followed the single troopers who were soon lost to view far away across the plains on the left and hills in the front and right. The earth seemed alive with an army of ants, or earlier, a gigantic game of prisoner's base, with mounted men, seemed to be going on. The patrols were soon followed by larger bodies, and soon the roar of the Horse Artillery mingled with the tramp of the Cavalry, as they followed up the reconnaissance of the 7th Corps as it sought out the enemy.

A similar scene was being enacted near Trosdorf, until the opposing forces began to touch one another near Putz and Grottenherten. It was very difficult to see accurately what now took place, the plateau being very extensive and level. The Horse Artillery of both Corps soon heard where the enemy had been encountered, and the scouts of either before Putz and Grottenherten fell back to allow the guns to come into action. A body of the 8th Corps Cavalry attempted to force back the 7th near Kirch-Herten by a charge; and other little affairs took place.

A desultory fire from the guns went on, during which followed a long pause, whilst the Infantry and remainder of the guns of both Corps were being brought into position. It was noticeable that the Cavalry of the 8th Corps withdrew, and the 7th made use of this pause and withdrawal by trying to gain the line Calbrath, Klein and

Kirch Trosdorf and Etgendorf, which position would leave an extremely open plain to be crossed by the advancing enemy.

The Infantry of the 7th Corps, in carrying out the above, slowly approached Kirch-Herten, whilst the Cavalry of the South Corps retire, and some Batteries of Field Artillery soon came up as the Cavalry and Light Artillery only were encountered, the remaining Infantry advanced all along the line to Putz and Grottenherten, and east and west of these places.

But the South Corps was still far away covered by their Cavalry Brigade, the North Corps continued the advance, companies in line and battalions in rear in column—Putz and Grottenherten being well garrisoned by Infantry under cover behind buildings, in yards, and on the side of banks or sunken roads—the main body still advanced, taking every advantage of the little cover to be found, and only stopping for water (during a very hot day) when they were invisible to the enemy. On the left the ground was more broken.

One remarked that where the line of troops was broken by a village, this village was very strongly held, and a blank space left for about 600 yards or more on either side, the Artillery being drawn back slightly, firing from behind the village or stacks, or whatever cover there might be. Thus comparatively few troops suffered from distant Artillery fire.

One gradually came to the conclusion that the South Corps had purposely remained in position near Bettenhofen, Oberembt, Niederembt and Kirdorf, in order to oblige the north Corps to advance over the almost unbroken plain for at least 2000 yards. It can be easily understood that neither Corps advanced across this dreadful strip of close-cropped stubble, as neither were desirous of being mown down as completely as the harvest had been.

Cavalry patrols made certain that no enemy was near, or attempting any sudden movements. The whole of the North Corps had advanced to the line passing in front of Calbrath, through Trosdorf to Schunkenhofen, and here encountered a heavy fire from the enemy's guns, which kept up a constant cannonade at 2000 yards range, from seemingly 4 groups of guns, near Bettenhofen, Oberembt, Niederembt and Frankshofen.

The North Corps on the left made a slight turning movement, as if to threaten the enemy's right flank or centre by Niederembt, but Cavalry appeared in such strength, backed up by Artillery and Infantry, that it was not carried out. About 36 guns of the North Corps answered those opposite Trosdorf trom behind and left of that village. The rest of the guns of the 7th were on the right centre and in reserve.

About 1.30 the "Critique" was held after the halt had been sounded and the troops rested for an hour. The fight was again taken up about 2 o'clock, the Artillery continued their fire, most of the Infantry rapidly retired, the Cavalry advanced, and under this cover both of the combatants withdrew to their places of bivouac, the Cavalry watching each other, then retiring to carry out their outpost duty.

The Crown Prince visited all the troops, galloping over everything that came in his way, and bade all his "*Morgengruss*."

Thus the first day of the combined Manœuvres of the 7th and 8th Corps consisted of marching and drawing up in battle array, and a slight Artillery duel, preceded by Cavalry and Horse Artillery manœuvres against Cavalry and Horse Artillery.

16th September.—The manœuvres consisted of an Infantry and Artillery conflict, the 7th (an east) Corps taking up a defensive position on the Erft above Caster, the 8th Corps advanced against it from the west. The position was very similar to the combatants at Worth—the defenders looking west instead of east. After some fighting the 15th Division managed to cross the Erft near Bedburg, and by a flank march attacked the left of the defenders. The left of the 7th Corps took up the defence of the line, Winkelheim Frauweiler and Rath, but lost the two latter places as the day closed.

17th September.—Was a day of rest.

18th September.—Another manœuvre of the 7th against the 8th took place two or three miles to N.E. of the scene of the 16th.

19th September.—The 7th Corps marched past and held their grand parade. Whilst the 8th marched back towards Euskirchen where they held their parade on the 23rd.

ALLATT'S PATENT HOBBLING APPARATUS.

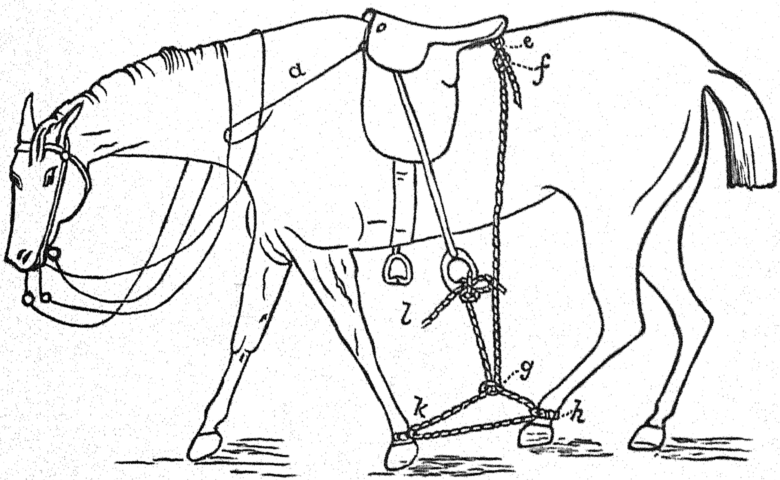
COMMUNICATED BY

THE SECRETARY.

Directions for using.

When the apparatus is not actually in use, but is carried on a horse so as to be available for immediate service, the boot shackles are carried one on each near leg of the animal, either above or below the fetlock joint. The whole rope is coiled up and strapped to the saddle at *e* or at other convenient position. A double-headed strap is used for this latter purpose, the inner buckle of which fastens the loop (*f*) in its position, and the outer buckle secures the whole rope when coiled up.

To hobble the horse as shown in the sketch, the rider dismounts and unbuckles the outer buckle at *e*; the end of the rope then falls to the



ground. This end is taken in the hand and passed (1) downwards through the eye of boot shackle *h*, (2) upwards through the eye of boot shackle *k*, (3) up through the loop *g*, and, finally, after having drawn the feet together as near as may be desired, is made fast to the stirrup or to a loop on the girth. When man and horse are trained, this operation of hobbling should not take more than half-a-minute.

The strap (*a*) is long enough to allow the horse to graze, and keeps up the reins.

When it is required to release the legs and to remount, the end (*l*) of the rope is unfastened and may be held in the hand while the rider mounts. Having gained the saddle the end (*l*) is dropped from the hand, and the legs are free. The rope is then seized by the rider with the left hand below the loop (*f*) and thus the extremity is pulled up through the shackle boots, and the whole rope is coiled up and strapped to the saddle at *e* on the first available opportunity.

It will be observed that the horse's legs need not be finally liberated until his rider is in the saddle.

After trying this system of hobbling on a large number of horses, it has been found that four or five careful training lessons, judiciously carried out, are amply sufficient to break most horses.

It is recommended that the first two or three lessons be given on soft ground. The method is perfectly safe. Horses soon become accustomed to it, after which they do not attempt to resist it. They have been left for hours thus hobbled. They can graze freely and appear quite at their ease.

The boot shackles are available for picketing in camp. They should never be buckled tight round the leg, especially in the case of a horse that will have to work in heavy ground with them on. They will not rub if properly fitted. They may be placed at will above or below the fetlock joint, and will work equally well on the two off legs.

The rope may be a continuous one, with a loop at *g*. This is available in camp as a single heel rope, or may be made into a V-shaped heel rope by attaching a head collar rope to the loop *g*.

It may consist of two lengths joined at the loop *g*. This latter construction is specially suited for camping purposes, for the part from *f* to *g* (having a loop at each end), may be used as part of the long line to which the horses' heads are attached in camp. This long line is thus formed of a number of short lengths connected together by the loops at their extremities. Each horse would carry the length of line necessary for his own standing room, as has already been recommended. The rest of the rope (*g h k l*) would be available for a head-collar rope. Where heel ropes are found to be unnecessary, this latter plan might be adopted with considerable advantage.

The apparatus can be had with the continuous rope, or with the rope made in two lengths.

MORAL OR *MORALE?*

BY

THE SECRETARY.

THERE has been so much wrangling recently about these two words, and there is still so much doubt as to which is the correct word to use in a military sense, that it is desirable to settle the question once for all. The following quotation from General Foy's "*Histoire de la Guerre de la Péninsule,*" *tom I.*, pp. 89–90, will be admitted by all reasonable persons to be decisive. There can be no appeal against a man who was at once a Frenchman, a brilliant General, and an excellent writer:—

"Mais si les Français marchent vite et long-temps, quoique petits et portant de lourds fardeaux, ce n'est pas seulement parcequ' ils sont bien conformés, et qu'ils mangent beaucoup de pain, c'est qu'ils excellent par leur moral." [1]

[NOTE.] [1] Cette expression, appliquée à une armée, est toute française, et n'a d'équivalent dans aucune autre langue. Le Colonel Henry Augustus Dillon, dans son ouvrage sur les etablissemens militaires de l'empire britannique, A Commentary on the Military Establishments and Defence of the British Empire (tom 1er, p. 137), dit, en parlant des troupes destinées à protéger l'Angleterre contre l'invasion, qu'elles possèderont ce que les Français appellent *tout le moral d'une armée;* et, pour expliquer sa pensée, il ajoute qu'elles seront animées du courage le plus franc, produit par le patriotisme le plus pur."

Moral, then, not *morale,* is the word an Officer would use with regard to his men, when dealing with the military side of their moral nature. *Morale* is the word a Chaplain would use to the same men, when exhorting them to temperance, soberness, and chastity.

FIELD TELEGRAPHS.

A REVIEW;

BY

LIEUTENANT J. M. GRIERSON, R.A.

"*Die Kriegstelegraphie in den neueren Feldzügen Englands*";

VON

R. VON FISCHER-TREUENFELD,

Früherem Major, und Chef der Kriegstelegraphen in Paraquay.

MAJOR von Fischer-Treuenfeld's book is, as its name implies, an account of the organization and operations of our Field Telegraphs in our recent campaigns in Afghanistan, 1878–80, South Africa, 1877–81, and Egypt in 1882; and is principally based on official (English) reports, papers read before the "Society of Telegraph Engineers," and papers published in the "Journal of the Royal United Service Institution," and in the "R. E. Professional Papers." For those therefore who make themselves acquainted with the current military literature of our own Army, there is little new matter in the work; but still it forms a valuable compilation on the subject of this most important branch of modern Armies.

In his preface, Major von Treuenfeld points out that in those campaigns we have had opportunities, not only of thoroughly testing the efficiency of our telegraph equipment, but also of determining to what degree the telegraph can be utilized to assist military operations. In the latter respect the campaign in Egypt is most interesting, as during it, short as it was, the Field Telegraph pushed its operations far beyond its former limits, and actually took part in tactical operations. The outcome of our experience in those campaigns has been the re-organization of the Field Telegraph Service, and the establishment of the Royal Engineer Field Telegraph Battalion, which was formed on the 1st April, 1884. In the matter of Telegraph Troops, permanently organized as such, we are therefore following in the steps of most Continental Powers—or leading the way as the case may be; but,

strange to say, in Germany and France, no permanent *cadre* of such troops exists in peace; the telegraph detachments being put together on mobilization only, officers and men being taken from those trained by the Engineer Battalions, and from the State telegraphs, who, however skilful individually, have never worked together in peace. The organization of our Field Telegraphs is characterized by Major von Treuenfeld as being thoroughly practical and suited to our requirements, and the arrangement by which the sections are rendered thoroughly independent and complete in themselves, is considered by him as well calculated to meet the necessities of war. The great development given to optical signalling in our army is specially commented upon by the author, and its introduction into the German Army strongly recommended.

We do not propose to enter into Major von Treuenfeld's account of the operations of the Telegraph Troops in the various campaigns, which are illustrated by sketch maps and plates showing the *matériel* employed, but shall only notice a few of his remarks and conclusions. In the Afghan war, the telegraph service was principally carried out by employés of the civil administration, the one military Telegraph Company (of the Bengal Sappers and Miners) available being entirely inadequate for the purpose. Full justice is done to the exertions of the civil employés, by whom no fewer than 420 miles of line were set up; but these lines were almost entirely of the nature of an "*étappen*" telegraph, and on no occasion was there any tactical utilization of a telegraph line. For tactical purposes, however, the signal detachments formed a most admirable substitute, and in a hilly country like Afghanistan, where there were numerous points from which a good view could be obtained, the most favorable conditions for optical signalling were found.

In the Zulu war, the Field Telegraph Troops only performed work on the line of communications, signalling being used for tactical purposes. The great disadvantage of an Army not being in telegraphic communication with its base was shown by the long delay in the news of the disaster at Isandlwana reaching England, caused by the want of a cable. Measures were at once taken to remedy this defect, but the works were not completed till after the termination of the war. It was only after the failure of the first invasion of Zululand that a portion of the Telegraph Troop was sent out to Africa, and, even after its arrival, the distances over which lines had to be carried were so great that the advance of the Troops for the second invasion was not accompanied by a telegraph line. Major von Treuenfeld concludes his remarks on the campaigns in South Africa as follows:—"We cannot but say that that Field Telegraphs in the proper sense of the word, *i.e.*, telegraph lines for conveying orders from Headquarters to Divisions on the march, or to troops operating on the battle-field, were not used at all, or as good as not at all. In the wars carried on in South Africa, the telegraph was only used for political, administrative, and strategical objects, but had never a chance of taking part in tactical operations. In consequence of insufficient supplies of *matériel*, and enormous difficulties of transport, and also as a result

of the want of a Central Direction of Field Telegraphs, and the consequent delayed employment of Telegraphs in the Field, those latter had always to remain in rear of the Army, and would therefore only act as a means of communication between the bases and along the lines of communication. It must, however, be remembered that almost all South African warfare consists of bush fighting, a circumstance which is in so far unfavorable for Field Telegraphs, as the construction and preservation of these in jungly and uncultivated ground, which can never be properly cleared of concealed enemies, are attended with special dangers and difficulties.

Doubtless these difficulties would have been overcome, and the Field Telegraphs would have had a much more extended sphere of action in the South African wars, as far as regards the political situation and tactical operations, if these campaigns had been begun and carried out with larger forces. So long as, on the outbreak of all wars, the English Ministry, from mistaken ideas of economy, only considers the first expenses of the wars, and therefore risks the success of the expedition, and the renown of the Army, by sending out insufficient forces, it cannot be expected that greater development will be given to the Field Telegraphs. These latter have hitherto always worked under the most unfavorable conditions, as they have always been sent to the seat of war *after* their absence from the army had been severely paid for.

For the operations of the Field Telegraph Troops in Egypt in 1882, Major von Treuenfeld has nothing but praise. Not only were the existing lines of telegraph repaired and worked by the four "sections" sent out, but the cable was taken out with even small reconnoitring detachments,[1] and at the battle of Tel-el-Kebir, the advanced Officer of the Field Telegraphs accompanied the Headquarter Staff. "This," says Major von Treuenfeld, "is the first case in history in which an English General has telegraphed the news of victory from the battle-field." In this campaign an Assistant-Quarter-Master-General for Telegraphs (Lieut.-Col. Webber) was appointed, who was placed in supreme charge of all military telegraphs, and thus unity in operations was ensured. In all, 26 offices were opened in the course of operations, and 5000 telegrams sent, one or two stations sending 150 to 200 on some days. "If these figures," says the author, "compared with other performances of the same class, do not appear very large, the endurance, precision, and 'keenness' of the English Field Telegraph Corps deserve the highest praise, especially if we take the extremely unfavorable local and climatic conditions into consideration."

It would appear, therefore, that real progress has been made in this most important branch of our Army. German critics are not, as a rule, "to our faults a little blind," but pounce upon them with avidity, and the British Army has much to thank its German comrades for in

[1] The translator saw a small detachment of the Telegraph Troop under Lieut. Foster, R. E., at the reconnaissance of Tel-el-Kebir on the 8th September, compelled by the near approach of the enemy to cut their cable and retire. Communication had previously been kept up by them between the force and camp at Kassasin.

the matter of wholesome criticism. When, therefore, we find a German author "to our virtues very kind," the dose is all the more agreeable. Major von Treuenfeld does not belong to the German Army, but is accepted in Germany as an authority upon Military Telegraphy; and when we learn from his work that the organization of our Field Telegraph Troops is decidedly in advance of that adopted in the well organized German Army, and that in our last war, undertaken against an organized enemy, the Field Telegraph was worked in a manner completely coinciding with the most approved modern ideas, we have good cause to congratulate our comrades of the Royal Engineers upon their success. Major von Fischer-Treuenfeld's work forms an excellent contribution to the history of Field Telegraphs in England, and will, doubtless, be welcome to all who desire to make themselves acquainted with their working in war.

BATTLE FIELDS

IN THE

LE MANS CAMPAIGN.

BY

CAPTAIN R. F. JOHNSON, R.A.

No. 10.

CHATEAU DuLOIR ROAD.

11th January.

To visit the part of the French line where it was pierced by the German Tenth Corps on the evening of the 11th January take train to Arnage on the Tours line.

Arnage (950 inhabitants) is a long village, lining each side of the La Flèche high road on the left bank of the River Sarthe. The French right extended to the northern end of the village at the level crossing where the sandy track called the Chemin aux Bœufs commences. Follow this track north-east; it is identical throughout with the French line.

At first the country is almost flat, sloping very slightly to the south-east. On the right (S.E.) there are small enclosures with high hedges and much timber and no field of view. On the left, a sterile tract of land covered with pines and heather.

Beyond La Guillardière farm the heather extends a considerable distance on the right, and about the Le Mans-Moncé road the country is open, but before Le Houx is reached the woods come down to the track on the left, and there are coppices and enclosures on the right. The houses marked on the left of the track in the map of the battle do not exist, but Le Houx is a small house with market gardens, extending from it to Les Mortes Aures (or Les Mortes Œuvres), which give only a narrow field of fire from the track down to the Les Epinettes water-course. On the left bank of this small stream are copses shutting out the country to the south-east.

At Les Mortes Aures the Chateau du Loir Road crosses the shallow valley, and commences the ascent of the ridge on an embankment, and the Chemin aux Bœufs has short embankments on each side of the crossing. The best view of the country is obtained from a knoll east of the crossing on the right of the track. All the low-lying ground can be seen as far as the ridge which runs from Parigné l'Evêque, on your left front six miles distant due east to Mulsanne, on your right front four miles to the south. In the middle ground is the village of Ruaudin (850 inhabitants), in the midst of meadows watered by the brook of Roule Crotte, which runs from near Parigné l'Evêque to the River Sarthe at Arnage. Beyond Ruaudin, on the ridge bounding the horizon, is the large village of Brette.

It is believed that the ground has been much cleared of wood since 1870, but it is now principally covered by large heather commons which give place to cultivation north of Ruaudin. The general view is like many in the New Forest district of Hampshire and round Aldershot.

On your left, the fir trees have been cleared away on the ridge as far as the Ruaudin road and the ridge itself recedes towards Le Mans (N.W.), but beyond this road a spur runs out to the south-east covered with well-grown forest. At the foot of the spur, in the midst of trees and enclosures, is the farm of Les Epinettes, where the midnight advance of a small column of Germans was checked by the French troops, who had not heard of the disaster which had happened to their friends, near the spot where you are standing, only a mile off on their right—an illustration of the advantage of a wooded position for troops, which are very liable to panic.

Les Mortes Aures is a small collection of cottages south-west of the Chateau du Loir road at its crossing with the Chemin aux Bœufs, and Le Point du Jour is another a little further south on the roadside near a thin line of fir trees.

On the 11th of January, General Lalande's Breton National Guards held this part of the French line, supported by two batteries and some mitrailleuses at the road crossing. The Infantry were placed in tiers of shelter-trenches on the slopes of the ridge.

The German Tenth Corps, which only came up into line late in the afternoon, being urged to strike at once so as to relieve the pressure on the Third Corps, fighting hard at Changé, three miles to the right (N.W.), sent against this position a force of 7 battalions, 1 pioneer company, 4 squadrons, and 12 guns, and held in reserve at Mulsanne $5\frac{1}{2}$ battalions, 1 pioneer company, 4 squadrons, and 54 guns. A flanking detachment of 2 battalions and 1 squadron moved to Ruaudin.

At first the Germans open fire with 2 guns and deploy 1 battalion, which drives in the French scouting party, but in the dusk the advance is stopped at the lowest part of the ground about 2500 yards to your front by the fire of the French batteries and mitrailleuses at Les Mortes Aures.

In a short time 6 more guns come into action, and the advance is resumed with $4\frac{3}{4}$ battalions in the first line, while $\frac{1}{4}$ battalion is sent to

occupy Les Hunaudières Chateau, which is in the trees 1000 yards west of the road.

At dark, Point du Jour is in German hands; but now the French Infantry pour a storm of bullets on to the ground in front of them, in the way which the Turks afterwards found so efficacious in 1877. Three-quarters of a battalion presses along the road and is nearly surrounded, when it is extricated by another battalion making a dash for the knoll you are on, which causes the French line to give way a little. Now the battle sways backward and forward in the dark, parties on each side being sometimes in doubt as to whether they have friend or foe in front of them; but the enclosures near Le Houx enable the German left to gain ground, so as to make it necessary to withdraw the mitrailleuses from their forward position, after which they can no longer sweep the road, as there is a bend in the cutting through which the ascent is made.

The German General knowing how untrained troops can never withstand the argument of cold steel, especially in the confusion of darkness, now sends a fresh battalion to the front with orders to charge up the road without firing a shot. At 8.30 p.m., after three hours and a-half fighting, the French line is pierced, and the villa called La Tuilerie (or Le Fouillet) on the top of the ridge is captured by the Germans.

On reaching this you will find it a small country house close on the right (E.) side of the main road. It is one storey high and has a round tower on its east side, from which the view must be very wide, for this is the highest point of the Changé ridge. The ground is fairly open and flat for about 600 yards towards Le Mans, and then falls at a uniform gradient to Pontlieue, which is two miles from La Tuilerie. On the left of the road you will see a tall factory chimney, which with La Tuilerie forms an important landmark. About 100 yards south of the villa a track crosses the main road, approaching it on both sides by short cuttings; this and the villa itself was occupied by 3 German battalions, while $2\frac{3}{4}$ halted a little in rear. At 10.30 p.m. the French made an attempt to regain their line, but their troops, many of whom were exhausted and dispirited by the rearward marches of the preceding days, could not be brought to close-quarters, and in consequence the Germans on the morning of the 12th of January held the position captured in the night, which was such as to make all the rest of the Changé ridge untenable.

This can be vividly realized from the heights north of the Huisne, and it is worth while to take the extra walk.

Regain the Chemin aux Bœufs and follow it to the Parigné l'Evêque Road, which is easily recognizable by reason of the tram-rails on its side. Strike northward through the woods for L'Epau, crossing the Pontlieue-Changé Road, where it crosses the head of a short but deep side valley leading down to the River Huisne. Take the road on the right (E.) side of this valley and keep to the left. L'Epau is a large country house and the well-preserved ruins of a large abbey, the whole surrounded by a strong wall and moat. (Orders to view can be obtained in Le Mans.) The woods approach it close on its south side,

but to the east there is a large open meadow. It would make a very strong post.

After passing L'Epau, bear to the left over a succession of foot-bridges to the mill, where it seems that a bridge to carry artillery could have been easily constructed. As it was, when the Les Noyers Chateau bridge was captured, the French right was only connected with the rest of their force by the Pontlieue bridges.

After crossing the river keep close to it until it touches the railway, then follow the road due north to the top of the hill, and then turn to the left (W.). About three-quarters of a mile further on a lane branches off at right angles to the left (S.), which is easily recognized as there is a small building at the corner, and about 100 yards down it there is a hurdle-gate leading into an orchard at a sudden turn, so as to give one the impression that the lane ends there. Follow this lane until it ends on meeting another at right angles. From a field in front the whole rear of the French right can be seen, and it is easy to perceive how the capture of La Tuilerie, which looks somewhat like a small chapel in the distance, obliged the abandonment of all the Changé ridge.

Le Mans can be entered by the narrow lane last crossed.

The whole walk is 11 miles.

(*To be continued.*)

ABU KLEA.

A PRIVATE LETTER FROM LIEUT. N. W. H. DU BOULAY, R.A.;

COMMUNICATED BY

THE D.-A.-G., R.A.

MY DEAR ——,

I believe this to be the 22nd; but we have been rather knocked out of our reckoning. We left Korti in a very long column, and marched pretty easily to Gakdul Wells, except of course that we had to be very careful of water, and couldn't think of any washing. Gakdul Wells are splendid, but of course we were rather a crowd there. We watered the animals the day we arrived, stayed one day more, watered again the next day, and started in a little more cautious formation. We marched to within six miles of Abu Klea Wells, and then had breakfast, hearing that the enemy was in possession of the Wells. We then advanced in a large solid square of camels, and eventually halted, dismounted, and began to prepare ourselves for the night, by making a sort of Zareeba about the place, into one of which our three guns were put. There was a hill on our right commanding us, which we could not spare men to hold. The Arabs got up there from about half-an-hour before dark, and for the whole night they kept up a dropping fire upon us which was very disturbing, but did very little damage; I think one man was slightly wounded, and three camels killed. We had one or two alarms during the night that they were coming on at us, and we were all ready, but nothing came of it. The next morning began an eventful day. We returned some of the fire from the surrounding hills on our right, and sent out skirmishers as well, who did uncommonly well; and meantime preparations were being made for a fighting square to advance and take the Wells, which were held in force by the enemy. It was during this time that Lyall when talking to me got a bullet right into his back, and fell in great pain; and just before one of our sergeants had his finger shot through. The fire got sharper as the skirmishers were withdrawn to join the square. We took our gun camels in the square, and then we advanced under a really nasty fire from the front, right flank and left flank. Every one was very steady, and fortunately only a few men were hit. We moved slowly on for a mile or so, Colonel Burnaby directing us, and then we got the guns into action and dragged them

with ropes, occasionally running them out and firing at bodies of the enemy—one shell we sent back to our right rear at some horsemen: it seemed to us to have burst too far off, but we learnt afterwards that it went right into, and dispersed a large body of horsemen who were making for the Zareeba in rear. The enemy was now all round us potting at us, but occasionally being cleared away by the skirmishers; whilst his main force was formed up on our left front in regular companies, with flags, &c. Suddenly we saw them move and come down at us, charging the left front corner of the square. Our three guns were got out, turned towards the enemy, and loaded with case shot. I was in charge of two, and Guthrie, who had taken Lyall's place, was in charge of one. I waited till the enemy was about 250 to 300 yards off, and then fired almost at the same time as Guthrie did. The result was an almost clean sweep of the enemy who would have come on the front face of the square. We could not well fire before we did, because there was a depression in the ground, and we should not have done much execution. Before we could load again the left flank of the square was broken, the enemy was in upon us, and we were fighting hand-to-hand. The square was broken in, but no one thought of turning or giving way; and the camels here helped us by forming a barrier between the enemy and the *right* flank of our square. A few minutes and the enemy turned and ran. Then we got to work with the guns again and kept up a fire upon them for a long way. At first all was confusion; the ammunition camels were hard to find, and whilst I was running for some I came upon poor Guthrie on a stretcher. His gun was on the left; and when the square was broken, he and a few others were left alone with it, and an Arab attacked him. Guthrie knocked him down, but the Arab made a cut at him from his knees. Gunner A. Smith saw it, just managed to ward the blow with a handspike, and then brained the Arab; but the knife had cut Guthrie's thigh and divided the artery. Guthrie nearly bled to death, but the wound was tied up just in time, and I hope will be all right eventually. I had my escape too: a man came at me, and tho' I wounded him with my revolver—he was close by—he got his spear to my left cheek close to my ear. At the instant I heard a kindly shot on my left, and he fell dead; and I came off with a scratch which just drew blood, instead of a nasty wound. When all was over the square moved on to the next hillock, leaving us, and the Naval Brigade, and part of the Hospital Corps where we were. We blazed away whenever we saw any enemy re-forming, and did really good work; dispersing them, and then getting back into the square. Just before we went, I saw a small-arm ammunition box on fire amongst the wounded on stretchers. I did my best to pull it clear, and got my hands burned in the attempt. We afterwards had all boxes of ammunition that could not be carried on set fire to. We halted a good long time, getting into order again, and resting, and having the wounded looked after. This was about 3.30 p.m. We had been at it since daybreak, and our thirst was intense, for it was awfully hot on the polished rocky ground. We had water with us, and about a quarter of a pint was dealt out after the hospital had been well supplied. The 19th Hussars

then came up on the left and went on to the Wells, and signalled back that they had found them and that there was fair water. That message just pulled us together, and we toiled on with our guns in the square, and encamped at the Wells, and drank, and drank, and drank.

The work our men had with the guns over all sorts of ground, right through the day, was immense. We only got in a little before dark, and had nothing to eat except biscuits that we had carried in our pockets. You can imagine how done up we all were, seeing that we had no rest the night before. When the square was broken in, the front face turned, most of them, three-quarters left-about, and the right face turned right-about, and you can imagine how the poor camels suffered in consequence. The rear face was thrown into confusion, too. Of all the men with the Gardner gun of the Naval Brigade, one only, Lord Charles Beresford, remained alive; and he was knocked down. Colonel Burnaby was cut to pieces at the first, but I did not see him.

Guthrie came to us in this way; he brought our camels to Halfa, and was there attached to a Transport Company which came on. At Gakdul this Company lent 130 camels to the Sussex Regiment to carry men, and Guthrie was sent on by himself to take them back again; so when poor Lyall was hit he, naturally, having no duty, and being a gunner, took his place, only to be wounded himself the same day.

The next morning we were all on our legs before daybreak, and about 7.30 a.m. were gladdened by the sight of our camels coming in all right—which meant food. We then had very hard work cleaning guns and filling water tanks, and making ready for a fresh start, which took place about 4 p.m. Lyall was carried from the Zareeba to the Wells on a stretcher. He was dying when we left Abu Klea, but I saw no more of him. He was the first officer shot.

We pushed on right through the night from Abu Klea, a terribly hard march for 25 miles, mostly in the dark; no bugle sounds, and no pipes to be lighted. At daybreak we were nearing Metemneh, bearing away to our right; but the enemy were sighted, and we halted. As they were in force we got the camels into a solid square, formed line outside each face, guns towards Metemneh, and awaited the attack. It came in the shape of a very hot fire from all sides, to which we were practically unable to reply, owing to the good cover which the enemy had got. Sir H. Stewart was wounded very soon, and many others. The gunners escaped, tho' we had many very narrow shaves. This went on all the morning, and I was so tired that I went fast asleep for a time with the bullets flying all about me. At last a resolution was come to to fight them; skirmishers went out; a fighting square was formed; and two strong Zareebas were made by the camels, in one of which were put all our guns but one, which was taken to pieces for lack of room. The square was to move to the river and establish themselves there: and it was a grand sight to see them move down steadily, occasionally firing a volley into the enemy's sharpshooters. After a time, the main force with flags and spearmen were seen going at the square. Then was the time for our guns—we put a round or two of shrapnel into them, which stopped them considerably, the square

itself finishing them off with a volley or two. Then on came another force on the other side, and the same thing happened. Then we were threatened again at our backs; then yet another force went at the square, but was dispersed, and we gave a great cheer. Then we all turned to squaring ourselves up, building up a rampart, clearing camels away from around us, issuing water. We were under Lord C. Beresford; Colonel Barrow, 19th Hussars, gave us all out the orders by word of mouth, and every man knew what was wanted. We had an alarm that night: every one was up in a moment in his place without the slightest noise—not a shot was fired—it was some of the 19th Hussars horses loose. Little Barrow was triumphant the next morning; he said it was the best show of discipline he had ever seen. As the square was reported to have established itself at the river, we made all preparations for moving down; and presently it appeared, and was received with loud cheers. We all got off in the afternoon, and moved down unmolested, leaving a small part with the sick. We bivouacked once more by the Nile, and gave the camels their drink after six days without water, and with very little food. The next day (22nd) we pretended to attack Metemneh, about three miles off, and advanced against it in square. We got a pretty hot fire on us from loop-holed walls occasionally; and finally were astonished by a big gun sending a stone shot *over* us, and a few minutes afterwards *into* us. Eventually the square was moved back.

Meanwhile four steamers of Gordon's arrived with the Khedive's flag flying, and a lot of his soldiers came on shore with three guns. So we took up a position and shelled the town a bit, but then retired to our old places; and since then have been entrenching ourselves, and moving guns from place to place and having alarms.

Yesterday three steamers went to Shendy and shelled it a bit; and I was ordered with two guns to our out-fort, just off the cultivation, and on higher ground, where the village of Abou Kru stands, or stood—for we have rather altered it. Having got up there and made myself comfortable, I was ordered down again, just as I was finishing dinner with the Guards, who are there as garrison. It was very nice having a wash after six days without taking off one's clothes. A large force of the enemy went into Metemneh yesterday. We should be able to hold our own against any number now.

We have had a terribly hard time since we first sighted the enemy, but to-day has been a rest.

Our force is small for the number of non-combatants and camels to be protected, and the numbers of the enemy to fight, and the communications to be kept up; but the men are as quiet as in barracks, and go about their business as though Metemneh was ours with all the force there dispersed. The behaviour of the men under fire has been very good from the first advance out of the Zareeba before the Wells, to the retreat from before Metemneh. In the first battle our guns were of course just outside the square, and we had to keep our heads clear of the men behind us—not pleasant. One gunner got a bullet right through his helmet from behind.

I felt proud of being a soldier when I saw our square go down to

the river in the second fight in splendid order, and send their volleys into the enemy, first on one side and then on the other. And I felt proud of being a gunner when, after laying and firing my gun, from the middle of the smoke I heard a loud cheering and clapping of hands, which told that my shot had been a good one, and had helped the square; and not only that one shot, but many others. We can't help calling our losses severe, with Lyall dying, and Guthrie wounded, and two men also wounded, though not very badly. The losses in our force generally are very heavy. I think there is no doubt the enemy funks us in the open now, but I know we can do very little more against them till more men come. At the same time we trust we shall be a considerable assistance to the others coming up behind us. Our difficulties are great owing to the impossibility of quick communication. A steamer or two goes to Kartoum to-morrow with a Company of Mounted Infantry and Sir C. Wilson.

Norton and I are both well and so are almost all the men; but we are awfully short handed, for we cannot get the natives to understand how to do things in a hurry. They behaved very well under fire.

Sir C. Wilson is the senior officer here now, but Boscawen is commanding as Wilson is off to Kartoum, and Colonel Barrow, I am glad to say, thus becomes Chief of Staff.

I remain,

Yours, &c., &c.,

N. W. H. du Boulay.

THE ARMING OF DRIVERS,

IN THE

FIELD AND HORSE ARTILLERY.

BY

CAPTAIN E. A. LAMBART, R.A.

In the District Orders of the Western District a few days ago, there appeared an order directing a draft of the Horse Artillery at Exeter to be prepared to join G/B on service in Egypt. Among the special articles of equipment for this draft was the item—"1 revolver per driver." I venture under the above heading to offer a few remarks for the consideration of my brother Officers on this article of Special Service Equipment in the Regiment.

In doing so, I am well aware of the strong prejudice that exists among the great majority of Officers in the mounted branches, against revolvers being issued as a permanent article of equipment to the drivers; but I have never heard any argument used in support of such prejudice, save the general and rather vague one, that the driver would be sure to make an improper and dangerous use of them; that is to say, that—given a revolver—the driver would think more of using it in a critical moment, than of giving his whole attention to his horses. On the other hand, the arguments seem to me to be as follows:—

1. That in almost all the Continental Armies drivers *are* armed with the pistol or revolver, and that in recent wars, there is no well-known instance of their using their weapons at the wrong moment.

2. That there is no more reason to suppose that because he has a revolver, a driver would be likely to open fire independently at the wrong moment, than that a hussar, for instance, who carries a carbine, would use it in the ranks without being ordered to.

3. That in recent campaigns revolvers, or pistols, &c., *have* been issued to the drivers whilst on active service.

In Afghanistan, a few Batteries received old M. L. pistols for this purpose, and in the first Egyptian campaign B. L. revolvers were issued previous to embarkation. At the Cape, I believe I am right in saying that, after the disaster at Isandhlwana, the drivers received swords. At least, I remember the celebrated N/5 arriving at Woolwich so equipped.

Now, whatever may be said in answer to the first two arguments I have submitted, it surely cannot be denied that if a man has a weapon he should be taught thoroughly how to use it, and this can only be done in peace time.

The Infantryman, on going to the wars, is supposed to be a master of his weapons, the rifle and bayonet; the Cavalry trooper of his multifarious equipment of sword, lance, and carbine; the gunner knows all about his gun; but the poor little driver receives along with his goggles, putties, and sea kit, a complicated weapon with which he may have to defend his life, but which he has never seen before, and is consequently more than half afraid of. There is an old feeling in the Regiment of "*ne sutor ultra crepidam,*" the gunner must not go beyond his gun, (though a sprinkling of swords and carbines are served out for him to amuse himself with in his leisure hours) and presumably the driver should have enough to do with driving and grooming his horses, as indeed he has in an English winter. But as some Batteries which take high places in the Annual Practice Returns contrive to turn out good swordsmen and carbine shots (a Field Battery in India last year won the Annesley prize against all the Cavalry Regiments—which is certainly going "*ultra crepidam*"); so it is surely possible to find time, without interfering with the necessary "Right take ground," and "Right reverse," to instruct our drivers in revolver practice. I have enlarged upon my last argument alone, as it seems strong enough to let me abandon the others, and I will leave them to others among my brother Officers who have more experience of British and foreign wars to support or refute.

I have broached the subject of arming our drivers again, in the hope of obtaining the support of some of the senior Officers in the Regiment; or, at least, of calling attention to the anomaly of a weapon being issued to men who are not trained to use it. I believe that the issue of revolvers to Batteries in peace time, only waits for the favourable opinion of Officers Commanding Batteries.

PRÉCIS

AND

TRANSLATIONS.

ITALY.

I.

L'ITALIA MILITARE,

7th AUGUST.

BY

LIEUTENANT G. E. WEIGALL, R.A.

MANUFACTURE OF STEEL GUNS.

HAVING completely succeeded in the manufacture of steel guns at San Vito (near Spezia), the authorities have decided to produce there a large part of the armament of the ships *Verniro, Stromboli, and Doria.*

30th August.

NOTES ON THE ITALIAN HORSE ARTILLERY.

Captain Sartinana, writing from Pordenone 27th August, describes shortly the new Horse Artillery Batteries. Each Battery on a war footing consists of 6 guns, 3 transport wagons, 1 forge, 1 spare carriage: the guns and ammunition wagons are 6-horse. For each gun the ammunition consists of 65 common shell, 70 shrapnel and 6 case. The gun is the 7^{cm} B.L. The carriage is unlike that of field batteries in that it is of plate iron, has a wider track, higher and stronger wheels, junction between carriage and limber elastic by means of springs, special limber divided in two compartments. There are 6 Batteries, but at present the Horse Artillery is attached by sections to different Regiments.

27th October.

Formation of two new Regiments of Field Artillery.

The formation of two new Regiments of Field Artillery (the 11th and 12th) on the 1st November, is announced. The first will be stationed at Alessandria, the second at Capua.

Each Regiment consists of 12 Batteries, a Depôt, and 3 Companies Military Train (*compagnie treno*).

Italy therefore now possesses 144 Field Batteries.

29th October.

France.—Launch of a new Ironclad.

The French journals announce the approaching launch of the *Caiman*, a large turret ship provided with a ram, begun at the end of 1878, and having cost 15,000,000 francs. The armament consists of two 42^{cm} guns in turrets, and moved by hydraulic power, $4-12^{cm}$ guns, and 2 machine guns.

The *Journal des Débats* says that the *Caiman* will be one of the most powerful ships of the French Navy.

31st October.

The Employment of Artillery *en masse*.

The *Invalide Russe* gives a few particulars of some experiments at Warsaw in the employment of large masses of Artillery.

A large quantity of ammunition having been granted by the War Minister, the experiments took place on the Artillery practice ranges and in the open country: in the former the firing was with shell, in the latter with blank cartridge. The results were most successful. The gunners and their Officers actually realized how difficult is the employment of Artillery *en masse*, and especially the proper distribution of the targets between a great number of pieces. Only after experiments many times repeated can any rules be laid down. This practice will therefore be repeated, and every detail of the problem accurately studied.

8th November.

The Swedish Army.

This number contains an article on the Swedish Army.

Manœuvres, at which the writer was present, took place last September in Scania, directed by the King. The Chief of the Staff was Colonel

Baron de Rappe, a distinguished officer who fought at Metz, in the north of France, and in Algeria in the French service.

The combined forces consisted of 14 Battalions, 24 Squadrons, and 7 Batteries of 4 guns each, or a total of 15,000 men.

They were divided into two Corps, one under the orders of Lieutenant-General Abelin, the other commanded by General Baron von Cedusström. The former, who had assigned to him the task of opposing the inland march of an enemy disembarking at Trelleborg, had a force of 6 Battalions, 16 Squadrons, and 3 Batteries. The latter, in command of the disembarking force, had the remainder, and thus more Infantry and Artillery, and less Cavalry than his adversary.

The writer gives no particulars of the movements of either force, difficult to follow without a detailed map, but mentions a few points which attracted the attention of the foreign officers present.

Bold innovation—instead of laying down daily certain preconcerted movements for each force, the direction left full liberty to the adversaries, only expecting to receive reports of their plans. In this way the manœuvres came much nearer the conditions of real warfare than is generally the case in peace manœuvres, and a much truer estimate of every element could be made.

However this mode might succeed with other armies, here it certainly gave the best results, and in view of certain changes contemplated in the Army, taught the War Minister and the country a valuable lesson.

The organisation of the Swedish Army is almost the same now as thirty years ago; with the exception of seven permanent regiments all branches of the Army are composed of men distributed in the country, collected, lodged, and fed by proprietors, and only combined once a year for their training. In this force, called the Indelta, may be found three generations of men as well disciplined and as devoted as the troops of Charles XII., and with good non-commissioned officers. The Infantry possess great powers of endurance, the Cavalry wonderful activity over broken ground.

Though possibly the men do not get all the instruction necessary for the soldier of to-day, they are splendidly officered, and any changes in the organization of such fine troops should be made with caution.

12th November.

Spain.—New Gun.

The new gun adopted by the Spanish Government for the armament of the Fleet was manufactured by the *Société des forges et chantiers de la Méditerranée,* after the plan of General Hanoria of the Spanish Artillery. It is 5·89 metres long, has a calibre of 161^{mm} at the muzzle, and 200^{mm} in the chamber, weighs 6200^{kg}, and throws a projectile weighing 60^{kg}, with a charge of $32\frac{1}{2}^{kg}$ of powder; the initial velocity obtained is 632 metres (2073 f.s.)

14th November.

Austria.—Re-Organization of Artillery.

According to the *Wehr Zeitung*, the Austrian Artillery will shortly be re-organized on the following basis: for each of the existing Regiments of Artillery will be formed—(1) 1 Regiment of 5 Batteries, with an ammunition column for a *Corps d'Armée* and a Depôt Battery; (2) three independent Batteries with a Divisional Ammunition Column and a Depôt Battery. The Regiment will constitute the Corps Artillery: the independent Brigades (*sic*) will furnish the Divisional Artillery. All the Batteries on a war footing will have 8 guns per Battery, each *Corps d'Armée* will have altogether 88 guns. A fourteenth group of Batteries will be formed besides for the Army of Occupation in Bosnia and Herzegovina; lastly, the Horse Artillery (for the 8 Cavalry Divisions) will be formed in 8 Brigades, each of 2 Batteries: total 16 Batteries, which, in peace time will be attached to 8 of the 13 Regiments beforementioned. The sum total of the Field Artillery for the active Army will be 170 Batteries with 1370 pieces.

The Artillery and the Landwehr Divisions will be provided with a permanent constitution of 9 Brigades, each of 3 Batteries, but with reduced *cadres*; that is, each Battery will in peace time have 2 guns, plus the *cadre* for a Divisional Ammunition Column.

The Mountain Batteries—as far as concerns administration—will be united with the Regiments of Field Artillery, instead of, as at present, to the Battalions of Fortress Artillery.

Résumé.—In peace time 197 Batteries with 1042 pieces: in war time 197 Batteries with 1544 pieces: plus 65 ammunition columns and 42 Depôt Batteries.

26th November.

Sweden.—Increase of Artillery Materiel.

According to the *Gazette Générale du Nord*, 34 Batteries of Krupp guns are to be formed after the plan elaborated by the King.

With this object, Parliament voted a sum of 801,000 crowns for the year 1880–81, out of a credit of 4,600,000, which appeared in the estimates. At this rate it would have taken 17 years to complete the Artillery matériel. In 1883, the King called for a new credit of 600,000 crowns. With this sum 24 guns with carriages and limbers, 48 ammunition wagons and stores for 3 Batteries were constructed, and besides, 70 wagons were modified to suit the new system. Altogether there are 25 Batteries out of the 34 proposed.

It is believed that when Krupp has got together the 66 guns which still remain to be manufactured, private industry in Sweden will be able to provide the remaining Field Artillery matériel. 50,000 crowns out of a credit of 100,000 have been spent on guns of position. It

will now be possible to complete the armament of the Fortress of Karlsborg, upon which up to now 475,000 crowns have been expended.

There is also a question of manufacturing B.L. guns of 15^{cm}, and it is proposed to spend more than 29,669 crowns on experimental practice.

4th December.

Steel Manufacture at Terni.

A great stimulus to the establishment of a large steel foundry at Terni, has been given by a contract made by the Minister of Marine with the Venetian Society of Construction, for the supply of armour plates. It is hoped in time to dispense altogether with recourse to foreign manufacture. Machinery on a most extensive scale has been ordered for the new factory, from Sevaing, Duisburg, Chemnitz, and Deneffe de Liège. Mr. Schneider, the Chief of the great Creuzot works, on a recent visit to Terni, highly praised the progress already made.

NOTES:

BY VARIOUS HANDS.

THE following letter is the reply to a letter from the D.-A.-G., R.A., returning thanks for the presence of the Band of the Royal Engineers at the funeral of the late Captain Goold-Adams, Royal Artillery, and the men of the School of Gunnery who met their death by the accident at Shoeburyness on the 26th February:—

"HORSE GUARDS, WAR OFFICE, S.W.,
"*6th March, 1885.*

"SIR,

"In acknowledging the receipt of your letter of the 3rd instant, I beg to assure you that the action of the Commandant, School of Military Engineering, in sending the Royal Engineer Band to Shoeburyness last Monday has been cordially approved, as it gave expression to the universal feeling in the Corps of deep regret for the gallant and distinguished Officers who came to such an untimely end by the accident of the previous week, and of warm sympathy with the Royal Artillery in their loss.

"It has given me much satisfaction to communicate your letter to the Commandant.

I have the honour to be,
SIR,
Your obedient Servant,

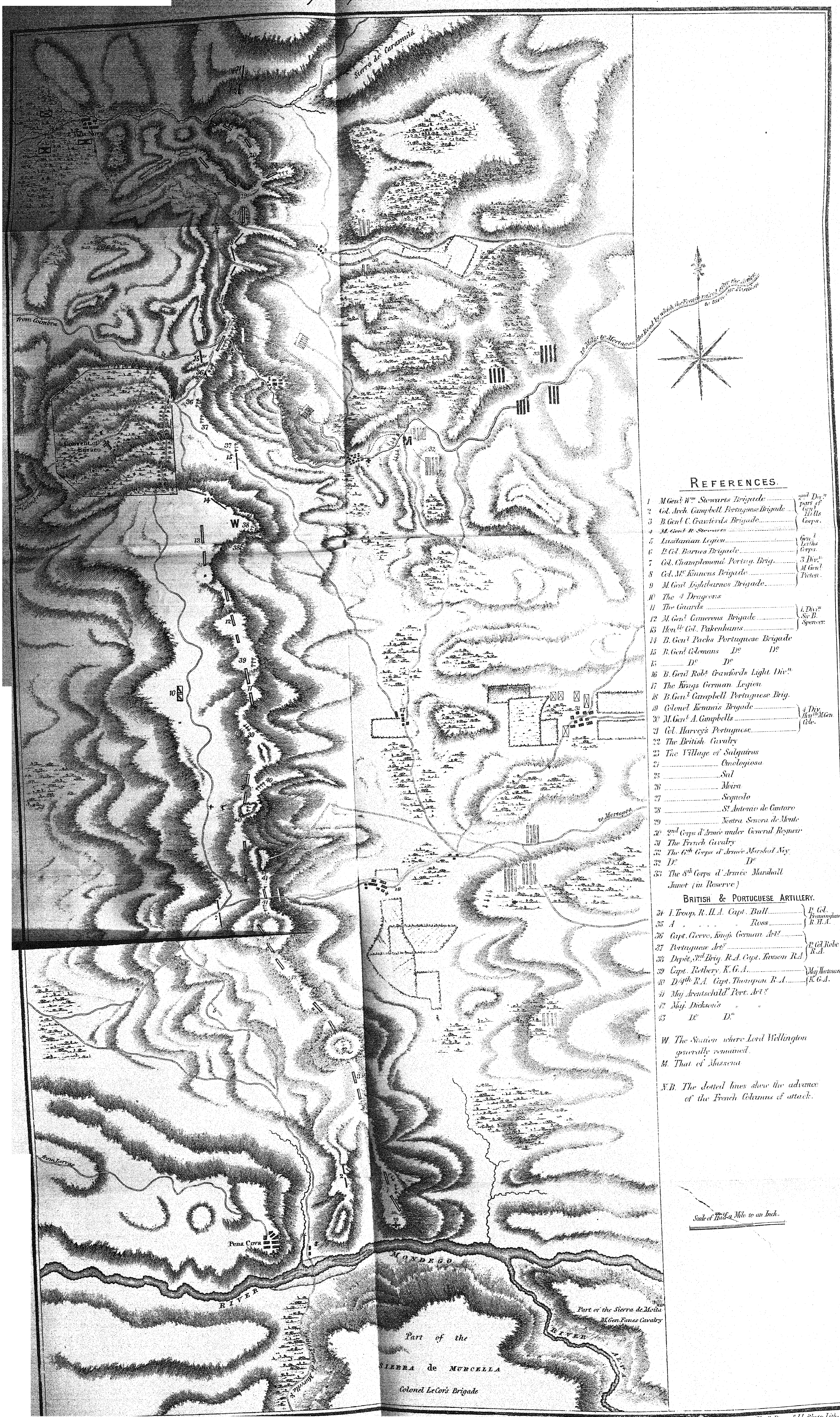
J. STOKES,
D.-A.-General, R.E."

"The Deputy-Adjutant-General,
Royal Artillery."

BUSACO is the second, and unfortunately the last map in the possession of the R.A. Library, Woolwich, with the positions and names of the various Batteries marked by the late Sir W. Robe, who was present at the battle. The present names of the Batteries are given in the plate.—*H.W.L.H.*

PLAN OF THE BATTLE OF BUSACO.

27th September 1810.



Fredk. Dangerfield Photo Lith. London.

REVOLVING SYSTEM OF SIGHTING GUNS.

BY

MAJOR L. K. SCOTT, R.E.

COMMUNICATED BY

THE SECRETARY.

HAVING been specially honoured with a request that I should write in the Royal Artillery Institution Papers, an explanation of the Principles and Application of my system of Sighting, which is to be tried by several Batteries in the course of this year; I will begin by giving, firstly, a short history of its origin; and, secondly, the reasons why the introduction into the Service of such a system is an absolute necessity.

It was in the month of May, 1872, when I was spending my sick leave (from India) in studying Hydraulic Engineering in a small office on Dover Pier, that I read a description in the *Daily News* of the Experimental Duel between the "Glatton" and "Hotspur," in which the "Hotspur" fired at the turret of the "Glatton" at a range of 200 yards, in a perfectly calm sea—and missed it!

This circumstance led me to suppose that there was something radically wrong with the sights; for I felt that no blame could be attached to a gun whose mechanical construction was regulated to the nicety of $\frac{1}{1000}$ of an inch. The question to be decided was—What was wrong with the Sights?

I seized the triangle of the "Marquois Scales," and held it up in imitation of a vertical plane containing the tangent sight and fore-sight (the short side of the triangle representing the tangent sight and the hypothenuse, the line of sight passing through the top of the fore-sight, which is at the apex of the triangle). I revolved the triangle, round its base as a centre, to the right and to the left, to represent the inclination of the sights due to the motion of the ship; and I at once concluded that the inaccuracy of fire had arisen from the "Hotspur" gun having been fired when the sights happened to

have been out of the perpendicular. How the possibility of such an occurrence was to be obviated in the future, was the problem to be solved: and the following is an explanation of the simple method invented for its solution:—

It was evident that some means should be devised for rendering the sights entirely independent of platform; and on observing the movement of the vertical plane (represented by the Marquois triangle), it struck me that the required system of sighting would be realized, if the tangent sight and fore-sight were contained in a vertical plane, which (being hinged to, and made to revolve round, a line parallel to the axis of the gun) could be turned at will into a vertical position when the gun wheels were out of level. This, then, is the origin of the theoretical principles which I have embodied mechanically in my Revolving System of Sighting, which is now under trial by several Batteries of Artillery. Since the year 1872, the date of my invention, numerous sights have been brought forward, but none of them have contained the essence of a true sight, viz., the "Revolving Movement."

In order to expose the defects of the Service system of sighting guns, and to show that improvements are much needed, I will begin by explaining the working of the Service sights, and compare it with that of the Revolving sights.

The theoretical principles involved in sighting ordnance are similar to those involved in sighting rifles, but the rules required for the gunner to make accurate shooting with the Service sights are far more complicated, and far more difficult to understand and to apply, than the rules for aiming the rifle.

For accurate shooting the gunner has to contend with five causes of error:—1. Drift. 2. Wind. 3. Sun. 4. Having to aim at distant objects not clearly seen by the naked eye. 5. Inclination of the sights due to the gun wheels not resting on a level platform.

How does the gunner provide against these five causes of error?

1. *Drift* is partially obviated by fixing the tangent sight on the gun at the permanent mean angle for rifling with the vertical. 2. *Wind* is allowed for by the "deflection scale," which corresponds to the wind gauge in the rifle. 3. *Sun.* The effect of the sun has been diminished of late in the 13-pr., by employing an eye-hole instead of a notch in the tangent sight. Some provision to obviate this defect could and should be made. It is obviated in Scott's sights by the use of a telescope, and by covering the fore-sight with a tunnel, as in the 13-pr. breech-loader. 4. *Having to aim at distant objects, not clearly seen by the naked eye.* This defect is not so applicable to the Infantry soldier as it is to the gunner, because the former fires at much shorter ranges than the gunner. No provision is made for assisting the gunner to aim at objects which are beyond the clear vision of the human eye; and consequently he fails to extract the best shooting qualities of the gun, because he cannot see to aim at objects at distances equal to the range of the gun. *Hence a telescope is an absolute necessity.* 5. *Inclination of the sights.* With the Infantry soldier this defect is

remedied by his placing the sights into an upright position, which is accomplished by his turning the rifle round in the shoulder till they are vertical. This simple method of obviating the great errors due to the inclination of the sights, naturally cannot be carried out in the same manner by the gunner, because he cannot twist his gun round in his shoulder.

This *inclination of the sights* is a constant source of error, delay, and annoyance to the gunner, because he has to make complicated calculations to remedy it, and is therefore a *permanent defect* in the present system of sighting. When he aims with a "line of sight" taken over inclined sights, he no longer aims directly over the axis of the piece, but across it. Hence he loses that command or control over the axis of the piece which is indispensable for accurate shooting, and which the Infantry soldier possesses by having the power to turn his sights into a vertical position at will.

What then must the gunner do to regain this command over the axis of the piece which he loses by his sights being inclined? He must calculate how much the notch of the tangent sight has been laterally removed from the vertical by the sight being inclined, and give this amount in "deflection right" or "left" to the notch of the tangent sight. Then if he apply this calculated correction to the tangent sight, he will regain, *according to the correctness of his calculation,* the command over the axis of the piece which he had lost by the inclination of the sights, because the notch is supposed to have been brought back again into the same position vertically over the axis, which it held when the sight was upright. A "line of sight" then taken over the notch and the tip of the fore-sight will enable the firer to direct the axis in any required direction.

How is this error due to inclined sights calculated in the field by the gunner? Let us suppose, by way of example, that the range is 4,000 yards, gun wheels resting on ground sloping to the *right,* and that a strong wind is blowing from the *right;*—1. No. 1 has first to find the elevation, in degrees, due to 4,000 yards range, say 9°, and to adjust his sight to 9°. 2. There is a strong wind blowing from the *right,* which will force the shot to the *left.* He must therefore counteract this effect of the wind by giving deflection, which he has to remember is "right deflection." How much right deflection is to be given? This can only be determined by those who have had great experience in actual practice in shooting. Suppose 10′ the correct amount of deflection, No. 1 gives 10′ "right deflection" to the notch of the tangent sight. 3. The *sights are inclined to the right.* The shot will therefore go to the *right* of the intended direction, and short. No. 1 must calculate the "deflection" required to counteract the error of the shot to the *right,* and then to remember that he is to give *left* and not right "deflection," otherwise the shot would go twice as much to the right as it would if no correction had been applied.

How does No. 1 calculate the required "deflection"? He uses Fitzroy's indicator, to find out how many inches the lower wheel is below the upper one, or he places the rammer on the upper wheel and

over the lower one, holding it, as far as he can judge by the eye, in a horizontal position. He then estimates the number of inches which the lower wheel is below the upper wheel, say 5 inches. He then applies the following rule:—"*Multiply the difference of level of the wheels in inches by the angle of elevation for the right or left deflection.*" The angle of elevation for 4,000 yards is say 9°. Therefore $9 \times 5 = 45'$ left deflection. But there being a strong wind from the right, which will blow the shot in the opposite direction to that caused by the sight being inclined to the right, he has to remember that a correction of 10′ *right* deflection has to be subtracted from the 45′ *left* deflection already calculated to counteract the effect of inclined wheels. Therefore 45 left — 10 right = 35′ left deflection as the correct "line of sight," under the above conditions. No. 1 then aims at the mark and the gun is fired.

If the correction has not been accurately made, the shot does not strike the mark, and consequently another calculation has to be made in the following manner:—He guesses the distance to which the shot has fallen to the right or left of the mark, which say is 20 yards to the *right*. He then applies the following rule:—"Multiply the estimated deviation in yards by 36 and divide by $\frac{1}{100}$ of the range." Therefore $\frac{20 \times 36}{40} = 18'$ deflection. No 1 has then to remember that the 18′ deflection found must be *left* deflection, which must be added to the 35′ *left* deflection already given to the deflection scale of the tangent sight for "wind" and "inclination of the wheels." Therefore 35′ left + 18′ left = 53′ left deflection is to be given to the sight. If this be found not to be correct, the same calculation will have to be re-made.

Unfortunately this correction will not ensure the mark being struck, because when a gun is fired on the natural surface of the ground another element of error creeps in after every round which *should be* but is never taken into account, viz., *the further inclination of the sights, from the lower wheel becoming more and more imbedded in the earth after each recoil.* These ever-varying alterations in the inclination of the sights after every round, however small they may be, necessitate, for accurate fire, the continual re-making of these mental calculations. Therefore the calculated and applied corrections for the first round from one gun are of very little use for a second round from the same gun, and unless the rules for calculating the corrections for each source of error as it crops up, be applied to each gun after every round, it will be *mechanically* impossible for the second shot with a field gun to strike the mark, even should the first have done so. Therefore, for absolutely accurate fire, if there be 100 rounds fired from 100 guns, 100 mental calculations will have to be made.

I would ask, is it likely that a man who is being fired at by the enemy can and will make those mental calculations on the spur of the moment? I should say that this is highly improbable. Hence the futility of the present system of Sighting.

I have been told by Artillery Officers that their men do not have half enough instruction in "Laying" and "Aiming" guns, nor half

enough practice in shooting. It is unfortunate that it should be so, but it cannot be helped.

The duties of the gunner are so multifarious, and he has so many other things to learn besides, that he cannot devote more time than he does already to acquire a thorough knowledge of his system of sighting, *though it is the most important part of his training*; and again, the State, on the score of expense, is not prepared to smooth his path by giving him sufficient opportunity of learning it practically by the expenditure of more than the regulation allowance of shot and shell.

What, then, can be done to make the gunner more efficient in the "Laying" and "Aiming" of guns *without the expenditure of more shot and shell?* If we analyse the question, we can trace the cause of all his difficulties in "Laying" a gun to his *faulty system of sighting*, which does not permit of his placing his sights at will into an upright position, and to the *want of sufficient ammunition* for testing, *practically*, the result of his "laying."

My Revolving System of Sighting, which has been used for years with such satisfactory results, solves the problem completely; for it will not only remove all difficulty in laying, but will, from its simplicity in its application, enable the gunner to become thoroughly efficient in shooting with no more than the present regulation amount of ammunition and training at his disposal.

It has been proved by actual practical results, that, with a minimum of intelligence, with less instruction, with less expenditure of time and ammunition, with far less trouble to the Instructors and themselves, Gunners can be made to extract the best shooting qualities of their guns, and to shoot, as a whole, about 10 times better in the field than they can at present with the Service sights.

The Revolving system of sighting consists in making sights for ordnance capable of revolution about an axis parallel in every direction to the axis of the gun. This revolving movement may be created by automatic arrangement on the principle of the pendulum, with the centre of gravity of the system of sighting below the axis of revolution; or it may be created by mechanical adjustment with the centre of gravity of the system of sighting above the axis of revolution.

The object of the invention is—1. To dispense with the errors of shooting due to the inclination of the Service sights when the gun wheels are not on the level, by making the sights (back or fore) capable of being turned back again into the same position with reference to the vertical which they occupied when the gun wheels were on the level. 2. To enable the firer to correct errors in range and direction by mechanical adjustments, instead of by the present method of calculation. 3. To give the firer complete command over the axis of the piece under all conditions. 4. To simplify the instruction required to be imparted to the gunner for the use of the Service sights, by converting mentally calculated arithmetical corrections for "deflection" into mechanical adjustment. 5. To supply the gunner with the means for utilizing all the various methods of "laying," and, finally, to dispense with all the defects and causes of error in shooting, inherent in the present system of sighting.

The principle of my system of sighting consists in giving to sights a third movement, in addition to the two movements already existing in the present system of sighting. The two movements of the present sights consist in a horizontal movement for giving "Deflection," and in a vertical movement for giving the "Angle of Elevation." The additional third movement in my system of sighting consists in causing the two above-mentioned movements of the Service sights combined, to revolve together about an axis parallel in every direction to the axis of the gun. No sight without these three above-mentioned movements, involving as they do the theoretical principles necessary for a true sight for guns, will give the firer complete command over the axis of the piece. I have therefore embodied these essential theoretical principles mechanically in sights for ordnance generally, and I designate sights made on these principles "Revolving Sights"; and where a telescope is used to aid the vision, "Telescopic Revolving Sights."

I will now proceed to describe how I have applied these principles mechanically in the example illustrated in the accompanying drawing. Fig. 1 shows the front elevation of a revolving back-sight fitting into the socket in the gun of the Service sight, together with the interior construction of the same; Fig. 2, the side elevation of the same; Figs. 3 and 4, Plate I., the side and front elevations of a telescopic revolving sight. *a*, Fig. 1, is a hinged flap graduated for different ranges, and fitted with a slider (*b*) also graduated for "deflection," which can be set at the proper elevation on *a*; *c* is a traveller containing the notch (*d*) and eye-hole (*e*) of the back-sight, which can be made to travel by the screw (*f*) for the purpose of giving the required "deflection." The flap *a*, Figs. 1 and 2, is hinged to an arm (*g*), both of which are made to revolve together round a hollow centre (*h*) by turning the screw (*i*), for the purpose of placing the sight into an upright position when the gun wheels are not on the level. The hollow centre (*h*) and the levelling screw (*i*) are fixed to the frame; *m* is the clamping screw of the slider (*b*). The stem of the sight fits into the socket in the gun; *k* is a level to adjust the verticality of the sights, and is fixed on the sight in a position at right angles to the axis of the piece. The whole of the interior construction is covered up, leaving merely the bubble exposed to view.

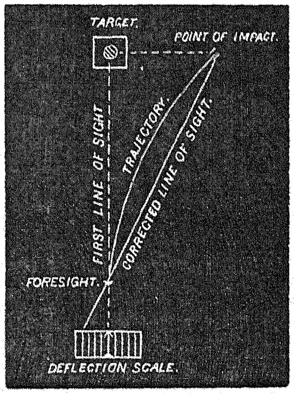
To use the Revolving Sight.—For the sake of comparison let us take the same conditions which I have already taken in the example for illustrating the working of the Service sights, and see how this is managed with the revolving sight. Range 4,000 yards; gun wheels on ground sloping to the *right*; strong wind from the *right*.

Let us take for example a *Battery* of Artillery about to fire at an object:—1. Adjust the sliders to 9° elevation; 2. Give 10′ right "deflection" to counteract force of wind; 3. Level the sights to dispense with the inclination of the wheels. 4. Aim. 5. See that the bubbles be in the centre, if not bring them to the centre and correct the aims. 6. Fire one gun only, the Nos. 1 of the remaining five guns of the Battery looking over their sights and watching for the point of

impact of the shot from the gun that is fired. If this trial shot of No. 1 gun hit the mark, the shots of the remaining guns of the Battery firing at the same range, will also go in the same direction. But if the shot do not strike but fall to the right of the mark, the Nos. 1 of the remaining five guns, who, as before explained, are watching for the point of impact, will at once move the traveller (*c*) of the slider (*b*) by means of the screw (*f*) to the left until the notch, the tip of the fore-sight, and the point of impact of the shot are in line. This operation corrects mechanically the error in direction of the shot, and shows at once the amount of deflection to be given. It is, therefore, only necessary to turn the guns laterally by means of the trails, and to aim at the object with this corrected "line of sight," and the shots will travel in the required direction.

Of course, the No. 1 of the gun which has fired the trial shot must borrow and apply to his sight this corrected "line of sight," so that when this gun is again fired all its succeeding shots will go in the required direction. Fig. 5 shows how the corrected "line of sight" is obtained by the deflection scale of the "revolving sights."

This very simple mechanical process[1] for finding the correct "line of sight," as compared with the complicated arithmetical method in use for the Service sights, demands only sufficient intelligence on the part of the No. 1 to turn a screw in the right direction, and sufficient training to enable him to take a correct aim. In fact, after a few



Diagram, in plan, explanatory of the process of correcting the "Line of Sight" of the Telescopic Revolving and the Simple Revolving Sight for the Error in Direction.

moments of practical instruction, any uneducated man (who could aim) would be capable of performing the necessary operation just as readily as the most intelligent mathematician, with results far more accurate than are at present obtainable "by calculation" with the Service system of sighting.

---

[1] This is infinitely superior to the German method of finding the range by trial shots. They are supposed to require 12 shots to attain this end, whereas one, or at most two, are sufficient by the proposed method. The German Battery would be annihilated during the interval of time which would elapse before the correct range was found.

This method, which allows of the correct "line of sight," being found for any number of guns by *one trial shot from one gun,* is an incalculable advantage, because after the correction has been once given to the sights, the rules to be applied by the Nos. 1 become reduced to the simple mechanical operations of (1) Levelling the sight; (2) of Aiming; and (3) of Firing; which will give accurate shooting whether the gun be on a perfectly level platform, in a ditch, or on the side of a hill, because the very fact of levelling the sight causes the gun to be fired from, as it were, a level platform.

This condition of things, therefore, gives to the No. 1 perfect command over the axis of the piece, which, with the Service system of sighting, when the wheels are not on the level, he catches at in vain by mental calculations which are not applicable in practice. It also gives to the Commander of Artillery far greater control over his Batteries, whose fire he can hurl at will with a constant unerring effect against an enemy, and, consequently, it makes him far less dependent on the intelligence of others for carrying out, in action, his own part of the programme to the best of his abilities, because it transfers to himself the power over the shooting of his guns, which is now uncertain, inasmuch as it is in the hands of the Nos. 1, who have to make accurate calculations.

Now let us examine what causes of error in the Service sights have been removed by the revolving sight. 1. Errors in shooting from *inclined sights* are dispensed with by placing the revolving sight into an upright position. 2. Errors due to "*wind*" and "*drift*" are corrected by the mechanical method of moving the deflection scale to one side until the notch of the back-sight, the tip of the fore-sight, and point of impact of the shot are in line. 3. Errors from "*sun*" are dispensed with by covering the fore-sight with a tunnel, and by providing an eye-hole instead of the notch.

From the above we see that all the causes of error in shooting inherent in the Service sights have been obviated by the revolving sight except one, viz., that one due to *not being able to see objects clearly at distances equal to the ranges of the gun.* To provide against this defect, I have added a telescope to the revolving sight, which, besides possessing other advantages, will enable the firer to see objects at the full ranges of the gun. This sight I designate the *Telescopic Revolving Sight.* It differs only in mechanical construction from the simple revolving sight just described. The principles on which it is constructed are similar, and the rules applicable in the case of the revolving sight, for correcting the range and direction of the shot, are equally applicable in using the *Telescopic* revolving sight.

In this telescopic sight we have, then, an instrument theoretically and practically fulfilling the conditions of a true sight for guns, which will enable the firer to utilize the best shooting qualities of the gun, and to produce those qualities at critical moments when called upon to do so, because the excellence of the shooting does not depend upon the coolness and intelligence of the firer for making mental calculations, but upon *mechanical adjustment,* in which there is very little to learn, and, consequently, very little to forget.

The Telescopic Revolving Sight, *see* Plate I. The telescopic sight is merely a revolving sight, with the deflection scale enveloped in a telescope. The angle of elevation is given by depressing the telescope by means of the screw (E), through the required number of degrees read on a vertical arc. The screw (E) is a micrometer-headed slow-motion screw, reading to two minutes. This micrometer arrangement dispenses with the difficulty of reading a vernier. Inside the telescope there are cross-wires, by which the line of sight is taken. These cross-wires are fixed to a sliding diaphragm, which can be displaced by the screw (R) to either side for giving "right" or "left" deflection.

The telescope is supported by two supports, one of which is the vertical arc. These supports are attached to the axis of revolution of the sight, which I call the trunnions of the sight; a cross level is fixed at right angles to this axis to regulate the verticality of the sight. From this axis project on either side two projections, one for holding the levelling screw (W), the other for placing under a spring which is fixed to the bracket. The hemisphere at the end of the screw (W) fits into a cup on the underside of the bracket. When the cup is in its place, the sight can be levelled by turning the screw (W). The bracket, which is rigidly fixed to any part of the gun, contains two grooves cut parallel to the axis of the piece, into which the trunnions of the sight are placed.

The introduction of telescopic revolving sights, constructed on sound principles, gives one new ideas and a new interest in Artillery fire, and develops an entirely new and simple system of "laying" guns. With the telescopic revolving sight the error of the shot in direction is corrected in the same manner as in the case of the revolving sight, by traversing the cross-wires (answering to the notch of the deflection scale) till they correspond with the point of impact. This process also corrects the error in *range*.

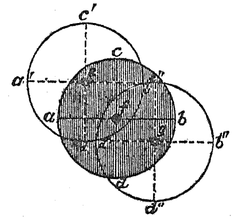
In order that the error in range may be rectified by the above method, the point of impact should be observed and corrected by a man looking through[1] another telescopic sight, from another gun alongside similarly adjusted for "elevation deflection," and aimed on the same mark as the one on the gun about to fire the trial shot.

Example.—Suppose a battery of six guns is required to silence in detail, by salvoes, batteries of the enemy coming into position at a range of 3,000 yards:—The Nos. 1 of each gun must aim with the same "elevation" at the same gun of the enemy's batteries, and in order to check the accuracy of the estimated range, No. 1 of No. 1 gun only will fire, the remaining Nos. 1 must each look through their telescopes to observe the point of impact of the trial shot. (*See diagram*).

Let *ab* and *cd* in the diagram represent the horizontal and vertical wires in the "fields" of the telescopes. 1. If the shot fall anywhere

[1] This has hitherto been invariably successfully performed by running the gun up again and by using only one telescopic sight.

above *ab* as at *e*, the Nos. 1 will know that the shot has fallen long and to the left of the object aimed at, and that the intersection of the wires *ab* and *cd* is to be brought into the dotted position $a'b'$ and $c'd'$ covering *e*, first of all by moving the telescopes *vertically* by



the screw (E) to correct the "elevation," and secondly the cross-wires horizontally by screw (R) to correct the deflection. After this operation the above-mentioned screws, for elevation and deflection, (E) and (R) must on no account be touched, but the aim in every case must be re-adjusted on to the target or object to be hit, by means of the elevating screw of the gun and by a lateral movement of the trail. The corrected elevation and deflection registered on the "vertical arcs" and "deflection scales" of the other guns must be applied to the sight of the gun which has fired the first shot.

Then to obtain accurate fire, the Officers will only have to see to the carrying out, by Nos. 1, of the simple mechanical rule of "Levelling the sight" before "aiming" and "firing," and they will, consequently, be in a position to devote their time to the watching of the effect of the firing and to the manœuvring of their Batteries, instead of making calculations which ought but cannot be made by the men. 2. If the shot fall below *ab* as at *g*, the shot will have fallen short and to the right of the mark, and the same rectification for range and direction as above described will be required, as shown by the position of the wires $a''b''$ and $c''d''$. 3. If the shot fall at the intersection of *ab* and *cd* as at *f*, the shot will have hit the mark, and no correction will be required to be made.

The power of being able, without mental calculations, to correct mechanically the error in range of a shot, in addition to the error in direction, gives great value to this system of sighting, and renders the instrument, in addition to all its other advantages of accuracy and simplicity, equivalent to a range-finder.

It is obvious that it is of no consequence whatever for the firer to know the exact number of yards that the shot has gone over or under the mark, provided he can adjust his sight, by mechanical means, so as to hit that mark. If the shot do not fall at the intersection of the cross-wires in the "field" of the telescope, it suffices for him to know that he has missed the mark, and that he must direct the cross-wires on the point of impact to correct his "line of sight."

By a simple arrangement the instrument could be used to find the range, and the resulting range could be applied to the "sights;" but

it by no means follows that a gun fired with the proper elevation for the range thus obtained, will hit the mark with the same certainty as when the correct "elevation" and "deflection" has been obtained by the above described mechanical method, which takes into account simultaneously, without any mental calculations, all extraneous deflecting causes at the time of firing, whether they arise from the varying force of the wind, the inequality of the powder, or the inclination of the "sights" from uneven platform.

If the enemy's battery were on level ground, or on ground sloping away from the position of your gun, the application of the above method for correcting the error in range would be difficult; but, *as a matter of fact, Batteries of Artillery would necessarily be in commanding positions with ground sloping to their fronts,* therefore this method could be carried out in the field just as well as in coast batteries in elevated positions above the sea.

The advantage of this Revolving System was particularly impressed upon my mind on one occasion when I was watching a Battery of five guns firing at some gun-pits. The Officers were superintending the practice and supplying the Nos. 1 with the elevation and deflection they thought necessary for the range. Nineteen or twenty shots were fired. One gun, I think, hit the mark twice, but none of the others hit it at all. Now, if all the guns had been sighted with the revolving sight, the elevation and deflection of the gun which had hit the gun-pit could have been at once borrowed from that gun and applied to all the sights of the other guns, and the result would have been that they would all have hit the gun-pits.

This, of course, could not be done with the Service sights, because the gun wheels were resting on rough ground, and consequently all the sights were inclined at different angles of inclination—some to the right, others to the left; whereas, with the revolving system of sighting, all the guns would be fired from, as it were, a *level platform,* whatever might be the inequalities of the ground. By this circumstance the Officers can attend to their other duties, and can have the firing of their Batteries carried out with certainty and regularity by salvoes, which plan of firing affords the following advantages:—

1. *That the enemy's batteries can be annihilated before they have time to change their positions.* 2. *That owing to the dispersion of the smoke the view to the front will not be obstructed by the smoke of guns fired independently.* 3. *That the disturbance of the aim which might take place in guns fired one after the other from the concussion is obviated.* 4. *That the Commander of the Battery has greater command over his fire.* 5. *That it prevents independent, unaimed, and random fire.*

There is a point of the greatest importance which, till lately, had not been taken into account by those who had to decide on the merits of this Revolving System of Sighting, viz., the little Training required by the Gunner to use these sights, as compared with the Amount of Instruction necessary to get over the intricacies of the old Service sights.

From the foregoing remarks, it is evident that the Revolving sights have developed an entirely new and practical system of instruction for the gunner in the laying of guns, and that great improvement in the shooting has been the result.

The question might be asked by the uninitiated :—Is any improvement in the shooting of guns necessary, and why? The answer to this question is :—*Compare the rectangle of shooting obtained at Shoeburyness, with the rectangle of shooting obtained in the field on Service conditions with the same gun.* Are these two rectangles equal to one another? Certainly not. The Shoeburyness rectangle, representing the best shooting powers of the gun, is 10 to 20 times smaller than the rectangle hitherto obtained in the field with the Service sights. This is proved by comparing the Shoeburyness rectangle of the 16-pr. M.L. gun with the rectangle obtained with the same gun on Service conditions by Major F. Ellis, R.A. The Shoeburyness rectangle is to the Service rectangle as 39 yards × 3·35 yards is to 50·2 yards × 13·6 yards, or as $\frac{1}{10}$ nearly (*vide* Plate).

The reason why there must be so great a disparity between the "Shoebury" rectangle and the "Service" rectangle *with the Service sights* is explained by the following :—

The "Shoebury" rectangle is to test the shooting powers of a gun. It is carried on in the following manner :—A calm day is selected, the charges are carefully mixed and weighed, the gun wheels rest on a perfectly level platform, an expert aims the gun at a fixed mark which can be distinctly seen, and which serves as the point of aim for all the distances at which the gun may be fired. In this manner series of ten rounds are fired with varying degrees of elevation, which are given by the quadrant. The several groups of shots thus formed on the ground are then carefully measured and transferred to paper, from which the rectangles are calculated into which 50 per cent. of the shot would fall.

The "Service" rectangle represents the shooting of the gun under very different conditions to those just described. An ordinary gunner lays the gun, the wind is blowing, the charges are not all carefully mixed and weighed, the gun wheels are inclined at all sorts of angles, and mental calculations for correcting errors in shooting have to be made. Under these circumstances it is not surprising that shooting under "Service" conditions with the Service sights must be vastly inferior to the "Shoebury" rectangle.

If there be so great a difference between these rectangles when such an expert as Major Ellis lays the gun, how much greater will it become when an ordinary No. 1 of a Battery, who has had very little practice, "lays" the gun? I maintain, therefore, that this fact in itself suffices to prove, quite independently of the evidence of the unsatisfactory results of Artillery Fire deduced from past wars, that great improvement in the shooting of guns in the field is necessary and possible. The Artillery ought, therefore, not to rest satisfied till the equation between the Shoebury and Service rectangles has been realized; or, in

other words, till they can extract in the field the best shooting powers of their guns.

Hitherto, with the Service sights, this has been an impossibility, but it is now placed within their reach by the adoption of the Revolving System of Sighting, as the following comparison between Shoebury and Service rectangles will show (*vide* Plate) :—

The "Shoebury" rectangle of the 5-inch B.L. gun at a range of 4298 yards with Service sights is 12·6 yards long by 1·72 broad.

The "Service" rectangle from a series of 11 shots fired from a 5-inch B.L. French gun with my Telescopic Revolving Sight, at a range of 5100 yards (800 yards further) is 26·24 yards long by 0·75 yards broad.

Again, the Shoebury rectangle with the Service sights from a 13-pr. at a range of 2750 yards is 29·55 yards long by 1·79 broad.

The Service rectangle with the Telescopic Revolving Sight from a B.L. French 95 centimetre gun, aimed by several men in the series of 11 shots, at a range of 2750 yards, is 5·54 yards long by 0·75 yards broad.

If further proofs, in addition to the Disparity now existing between the Shooting Powers of the Field gun as represented by the Shoebury Rectangle and the Results actually obtained on Service, were needed to show that an improved system of "Laying Guns" is necessary, we have only to draw upon the Statistics of the killed and wounded by Artillery fire during the most recent wars, and to contemplate thereon; for instance :—The mean of the wounds received in the last great wars of Italy, America, Denmark, Bohemia and France, was found to be, by the Rifle, 80 per cent.; by the Sword, 2 per cent.; by Artillery, 18 per cent. At the last Siege of Kars, 48,000 projectiles fired by the Russians touched 308 persons, of whom 105 were killed, *i.e.*, 136 shots per person touched at a mean range of 3,900 yards. In 1870, the Prussians fired 10,000 projectiles against Paris, killing 107 persons. Le Bourget was cannonaded for six hours by 18 pieces of Artillery, wounding only three men!

No end of examples could be quoted, showing the small effect hitherto produced by Artillery fire.

These results appear astoundingly small to anyone who knows what the destructive powers of a gun are, when properly handled. The cause evidently was that a great deal too little attention had been paid to the development of the shooting of the gun. The system of sighting was wrong, and therefore no proper system of training the gunner how to extract the best shooting powers of the gun was possible. Consequently the guns must have been fired in a happy-go-lucky kind of way, without any method, without any deliberation, and probably, very frequently, without any aim.

What is wanted is, that the minds of those who use guns should be imbued with the idea, firstly, that the utility of guns, their *raison d'être* in fact, entirely depends upon their shooting powers; secondly, that the development of their shooting powers is dependent upon such a system of training that the gunner will know by instinct without hesitation (1) What to aim at; (2) What kind of fire; (3) What method

of "laying"; (4) What nature of projectile to employ, for every contingency of warfare.

It is a most extraordinary fact that, although many articles on Artillery subjects, such as on "The penetrative power of a gun;" "On the Manufacture of gunpowder"; or on "The shape and size of a gun, &c.," are being constantly written in England, yet I have never read any suggestions on the best means for utilizing the shooting powers of the gun.

In the Practical Instruction for the uses of the Revolving sights, supplied by me to the Batteries, are described some of the various methods of "Laying" guns, and When, and How they are employed.

Some of the methods for aiming are: *Direct aim*—when the line of sight is directed on to the object. *Reverse aim*—when the line of sight is directed upon an object in rear of the gun; this would be necessary when a gun was to be fired from behind some cover, such as an epaulment, a wall, a house, or the brow of a hill. *Night aim*—*Aim for breaching purposes. Aim for a moving object*—*Lateral Aim*—when a reverse aim is impossible, &c. All these the Gunner ought to have at his fingers ends, together with the means for putting them into execution. He ought also to know when to employ Direct or Curved fire, when Shrapnel, Common shell, or Case. For instance (1), for troops in the open—Direct fire; shrapnel and common shell. Cavalry in movement; common shell with percussion fuze. (2) For troops behind cover, such as a parapet of a work—Curved fire; common shell with percussion fuze, if defenders remain under cover; or shrapnel with Direct fire if the defenders expose themselves on the parapets. Troops behind shelter-trenches, Direct fire with shrapnel. Troops in casemates underneath the parapet, Direct fire with common shell, with retarded action fuze. (3) For finding the range—Direct fire; common shell with percussion fuze. (4) For breaching with Field guns—Direct fire; common shell and percussion fuze. (5) For firing at a ship—Direct fire for piercing the sides, and Curved fire for the decks, &c.

Curved fire may be produced either by firing at a long range, or at a short range by reducing the charge. Some means, therefore, with Field guns ought to be available for the immediate reduction of the charge by a fixed quantity, either by making up the Service cartridge into two or more separate cartridges connected together by quickmatch, which could be cut asunder, or by some other means.

I do not pretend to have elaborated a perfect system of training by the above few remarks; but sufficient has been said to show that a regular system of instructing the gunners in all methods of "Laying," &c., should be carried out.

I will now say a few words with regard to Telescopic sights and Shields for Field guns:—

Telescopic Sights.

Everyone is agreed that all Sights should have a Revolving Movement. Everybody is now agreed as to the necessity of Telescopic

sights for (1) Guns of position; (2) Siege guns; (3) Howitzers; but I have heard doubts[1] sometimes expressed by a few Artillery officers as to their necessity for Field guns. These doubts I hope to dispel by the following remarks:—

What does the Use of a Telescopic sight with Field guns mean? *"It means increasing the Range and Accuracy of the Aimed fire of field guns."* To have doubts, therefore, as to the value of, and necessity for, a Telescopic Sight for a Field gun is, to ignore that the great revolution in Tactics, which has taken place of late years, has been entirely ruled by the development of the shooting powers of modern weapons. To refuse to utilize every available increase of these Shooting Powers is, not only to deprive the Artillery of technical advantages of superiority but to handicap unnecessarily the other Branches of the Service which might be entirely dependent on the aid of Artillery fire for the successful execution of their operations in the Field. I hope, therefore, that I may be pardoned for suggesting that these doubts may arise—

1. From these officers never having used a Telescopic Sight on the Service conditions of a European war, and, consequently, from their not having hitherto realized its advantages.

2. From their not having considered the question from a Tactical and Fortification point of view, which certainly ought to be done.

3, and lastly, perhaps from a feeling that any development of Artillery fire is good enough for our Foes, who are usually Savages unarmed with Artillery; or that the time is very remote when we may be brought face to face with Improvements in Fire forced upon other European Artilleries by recent experiences.

For, if this question of telescopic sights for Field guns be regarded from a Fortification point of view, it is evident that the Increased Range and Accuracy of Aimed fire brought into play by the use of a Telescopic sight must be of the greatest value to the Engineer, and to the Infantry soldier, in the Attack and Defence of Works and Posts, and must also tend still further to modify, as it has already done, the Tactics of an Army in the Field.

We have only to study the accounts of the Attack and Defence of the various Posts and Villages in the Franco-German war to understand what the value of Telescopic-sighted Batteries would have been in preparing, *out of range of the enemy's bullets*, the Infantry attack on such places, by being able to pick out, enfilade, and demolish those special parts, such as Bridges, Obstacles, Houses, Batteries, Barricades, Streets, &c., &c., which had been put into a state of defence, and which could not be distinguished by the naked eye.

---

[1] It will be observed on the perusal of the rescue of Sir Charles Wilson, R.E., by Lord C. Beresford, that the latter has a practical appreciation of the value of Shields and Telescopes. He says: "Owing to the protection afforded by the Armour Shield the enemy's rifle fire did very little damage." Again: "In the stern of the steamer, a hole made by a round shot afforded an excellent position for an Officer to observe the Battery through his Telescope, and as soon as one of the enemy put his head over the parapet to take an aim he was greeted by one turn of the handle of the Gardner and a volley from six of our marksmen."

Hear what General Lewal, the present French War Minister, says in his "*Tactique de Combat,*" from practical experience gained by the Franco-Prussian War:—"Il ne s'agit plus ici de théorie ni de système, ce sont les faits, les chiffres qui dècident et nous disent: le feu est la grande, la principale, et presque la seule force de combat; le choc n'est plus qu'un accident secondaire. Tous les efforts doivent se tourner vers le bon emploi du feu, voilà l'avenir . . . . On déduira forcément cette conséquence que le dispositif tactique rationnel consiste à augmenter les effets du feu sur l'ennemi, en se sonstrayant soimême, le plus possible, à celui de la partie adverse." *This is exactly what a Telescopic Sight enables one to do.*

Looking at the question from a Tactical and Artillery point of view, Telescopic-sighted Batteries have the advantage, owing to improved powers of aiming, of being able, with less danger, to cover their advancing Infantry by firing over their heads; and, moreover, they can continue to fire in the same position for a maximum of time without moving, which is a result worth cultivating when we realize that the useful effect of Artillery ceases directly the guns begin to be set in motion.

As Tactics, therefore, have to conform to the development of the destructive effects of Fire, it is evident that the value to the Service of improvements involving such changes should not be considered merely from a technical Artillery point of view, but from a general view of the advantage to be gained to the other branches of the Service by their adoption.

The advantages inherent in Telescopic sights, and in the new Revolving System of Sighting, are so numerous that I cannot enter upon them now, but a summary of them will be found at the end of this paper.

Shields.

Now, with regard to the question of Shields, Colonel Brackenbury, who has had an opportunity of judging practically of the effect of the fire of modern weapons, has maintained for years past, and I believe was the first to maintain, that Shields are necessary. If, when fighting against Europeans, we are going to bring our guns within the effective range of the enemy's rifles and machine guns, Shields are indispensable.

Skoboleff, ignorant of, or ignoring the effects of the fire of modern weapons on the 11th Sept., at an attack on Plevna, ordered 24 guns to approach within 660 yards of the enemy's works. In one minute all the guns but 8 were silenced, and these latter had to be drawn out of action by the Infantry with drag ropes. The Batteries were one confused mass of slain horses and men. I need hardly say he did not try this move again, but duly acknowledged that modern fire had changed such tactics. Had he had shields the guns might not have been silenced.

From the generally prevalent idea in England that a European war

for us is highly improbable, we do not entertain the question of Shields in a sufficiently serious and thoughtful manner.

How are the Shields—or it may be any other such improvement—to be carried? is generally the first question brought forward as an argument against their introduction. Surely if they be worth having they are worth carrying. There are plenty of solutions to this question. Why not dispense with one gun of a six-gun Battery and utilize its team of horses for the transport of a Machine Gun laden with its own Shield and with the Shields for the other five guns? The Machine gun might prove invaluable at times for the protection of the guns of a Battery, and its addition would in no way detract from the utility of Artillery. Each Arm is necessary. Each Arm has a most important and a perfectly distinct *rôle* to play. No sane man can imagine that either can be dispensed with in any future European war. On the contrary, Artillery has a greater future than ever before it. It is true that I have heard some officers (not Artillery or Engineer) say, without thought, that Artillery is of no value.[1] I only trust that they may be able to persuade our European enemies that such is the case, and induce them to part with theirs before we come to blows. One thing is quite certain, if you do not have Shields, which render Aimed fire not only possible but probable at short ranges, you must have Accurate Long Range Fire, and this you cannot have without a Telescopic Sight. Hence all improvements tending to increase the development of Artillery fire should if practical be adopted without hesitation. There is generally, however, the too ready argument of Delicacy raised against such a course by the Indifferent, and that of Want of Funds by the Government. The cry of delicacy is very often a false and misleading cry, which can be carried too far. This was probably the cry of the Austrians against breech-loading rifles before the Prussian war of 1866; and we know what their dilatoriness in their adoption cost them at the village of Podol, where, not being able to use their ramrods to load with from being crowded together in the streets, they were shot down in defenceless masses by the breech-loading needle-gun of the Prussians.

When it is a question of making a trial of an Instrument which is to import great improvements into the Service, the Theoretical Principles of the instrument should be considered quite apart from its Mechanical Construction. If the theoretical principles be found to be correct, then, before deciding to condemn it as unpractical, every effort should be made to overcome any fault which may appear in its mechanical construction.

If a certain amount of so-called delicacy is necessary for the production of accuracy, that amount of delicacy ought to be accepted which is manageable with the maximum amount of care, which in the Service could be bestowed upon it. Such instruments, moreover, ought never to be exposed to *unnecessary* risks, nor to unnecessary rough

[1] How gladly would the handful of brave men at Gubat at this very moment welcome the arrival of a Field Battery to smooth their way into Metemneh and Berber.

usage. One's watch would not last many minutes if one tried to find out how much rough usage it could stand. On the contrary, careful handling and treatment should be the order of the day. The age for poking the fire with one's musket is a thing of the past. We invariably make the grand mistake of trying to manufacture articles strong enough to last for ever. What we want is for them to last long enough to win a victory. Science advances every day, and if we are to survive, we must go with it.

From paucity of funds our Committees are constrained to hang back from adopting improvements into the Service as they come out, lest something better might be brought out a week, a month, or a year hence. During this interval of time the now not so highly improbable European war may break out. Then everything is done in a hurry. The last thing out is adopted at great cost, and the men being wholly untrained in its use, do not reap the benefit which the improvement should afford them: then follows disaster, and we know what that cost the French—£250,000,000, or about one-third of the whole of our National Debt.

Is it not more politic? Would it not be cheaper? (for that appears to be the point nowadays) to spend monthly a few thousand pounds in supplying our small army with every improvement, and even luxury, in science as it crops up, than to court and probably reap disaster from the want of it.

We timidly ask:—What are the French doing? Have the Prussians adopted this or that invention? Who cares what the French or Prussians have done? Are we English Officers not as capable of judging of the value of an invention as well as a French or Prussian Officer? Do we acknowledge inferiority in education, in common sense, to these officers? Are we less practical? If not, why do we wait for their opinions? Why don't we anticipate them rather in their opinions, and steal a march on them quietly, so that in the event of war we may collide with advantage? The answer is not far to seek—"*Not Enough Money.*" The money granted is so much below the requirements of the Service, and the calls upon it, for the required improvements, are so numerous, that the unfortunate Heads of Departments do not know where to begin to spend the small grant to the best advantage. Whose fault is it? Nobody's else but that of the People. They do not seem to grasp the situation. If they did they would strengthen the hands of our Responsible Ministers, by insisting that our Army and Navy should be kept in improvements a-head of all the world. We must not allow ourselves to be lulled into a false sense of security, by the supposition that we shall always be left to go our own way in peace by foreign nations, and that none but savages unarmed with modern weapons will be our foes. When we do go to war against Europeans we shall find that they have learnt to benefit by recent lessons in war; and I trust that, when the time comes, We, too, shall not be found wanting.

Summary of the Advantages introduced by the New Revolving Sights.

Advantages peculiar to Telescopic Sights.

1. The No. 1 can see to aim at distances equal to the range of the gun.
2. He can discover and fire at objects not capable of being seen with the naked eye.
3. All personal error in laying a gun is entirely eliminated, for the taking of a correct aim is independent of the human eye, and of any practice on the part of the No. 1.
4. The No. 1 can employ Direct, Reverse, or "Lateral" aim, or Night aim with the same Telescopic Sight.
5. He can tell, by watching the impact of the shot in the field of the Telescope, whether the point aimed at has been struck.
6. An effective fire can be carried on outside of the range of the enemy's bullets, and it can be continued from the same position for a maximum of time.
7. Telescopic sight obviates the necessity for long tangent sights for high angles of elevation, and their inaccuracies.
8. You can see to fire at your enemy before he can see to fire at you, if he be not provided with a Telescopic sight.
9. Specially defended parts of villages, &c., which could not be seen without a Telescopic sight, can be picked out and demolished, thereby materially assisting the Infantry attack.
10. Specially useful for a Line of Investment.
11. Telescopic sights can be used as Range-finders and Battery telescopes.
12. The shooting of a Field gun on the natural surface of the ground and aimed by anyone who can aim properly, will be, without the use of any calculation whatever, three times better at short ranges, and ten times better at long ranges with the Telescopic sight than with the Service sights.
13. With a little practice, when once the angle of elevation and deflection shall have been given, no matter what man, will be able to aim in all weathers *more rapidly than with the Service sight.*

Advantages of both the Telescopic and Revolving Sights.

1. That the firer has that complete command over the axis of the piece under all conditions which he has with the present sights only when the wheels rest on a perfectly solid and level platform.

2. That all calculations are eliminated, thereby enabling any uneducated gunner to learn to shoot accurately, provided he has got good eyesight, without the expenditure of ammunition or special training.

3. That the effective power of the gun in action will not depend upon the life of No. 1 of the gun detachment, because every gunner can learn to use these sights.

4. That the instruction to be imparted to the men will be much simplified.

5. That the destructive power of Artillery would be enormously increased.

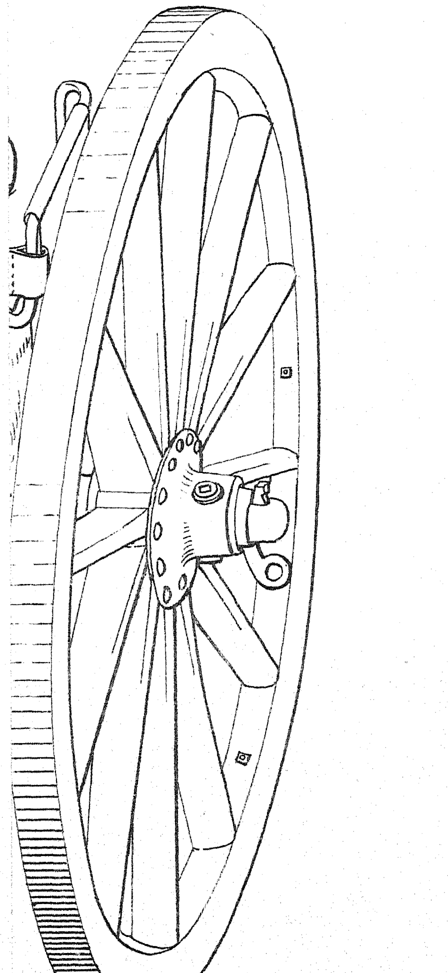
6. That a maximum effect will be produced by the expenditure of less ammunition than hitherto, and therefore the necessary amount of transport will be reduced to a minimum.

7. That a level platform not being required, the Artilleryman will be no longer in the anomalous position of being dependent upon the work of the Engineer for accuracy of fire, and considerable expense and trouble will be saved in permament fortification.

8. That all calculations are eliminated by *mechanical arrangements*, which *must* be far less liable to error than when left to the judgment of the firer.

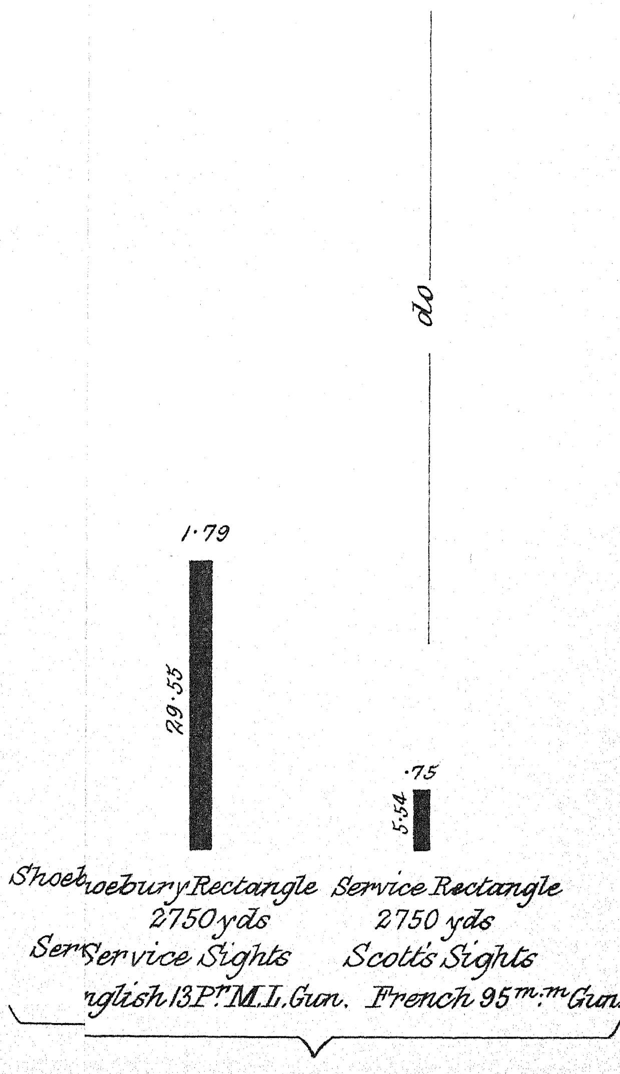
9. That the manipulation of the instrument can be learnt by any man of the smallest intelligence.

10. When once the true elevation and deflection have been found, they are not disturbed, and consequently there is no chance of any error being made from the No. 1 having to set the sight each round; because the revolving sights are lifted out of the socket or grooves intact before firing.



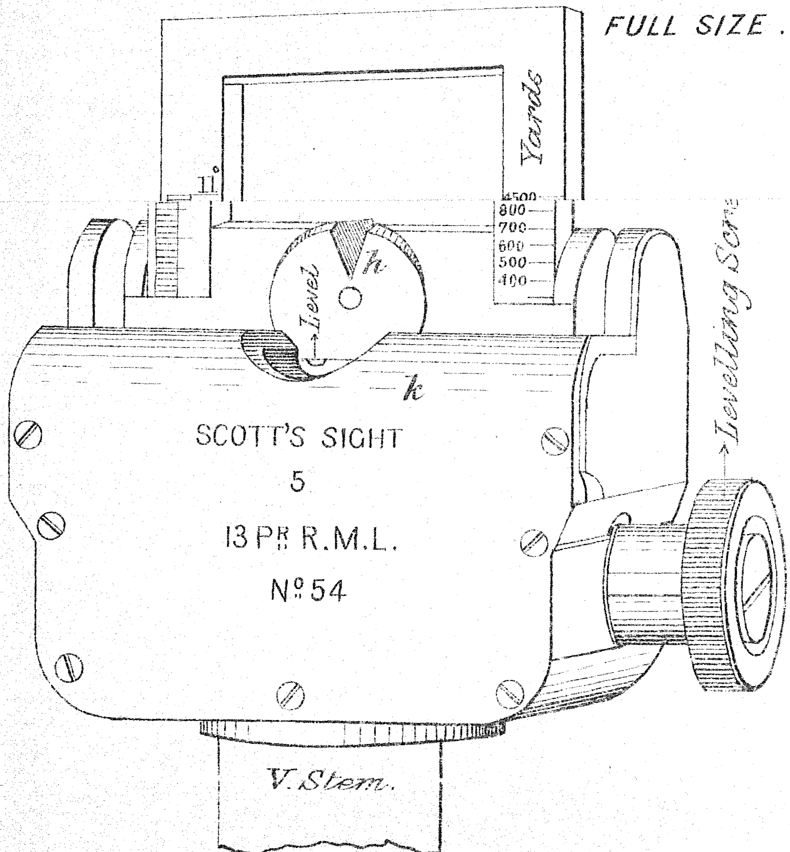
1885

ʼUNS, AND THOSE
ʼH THE SERVICE

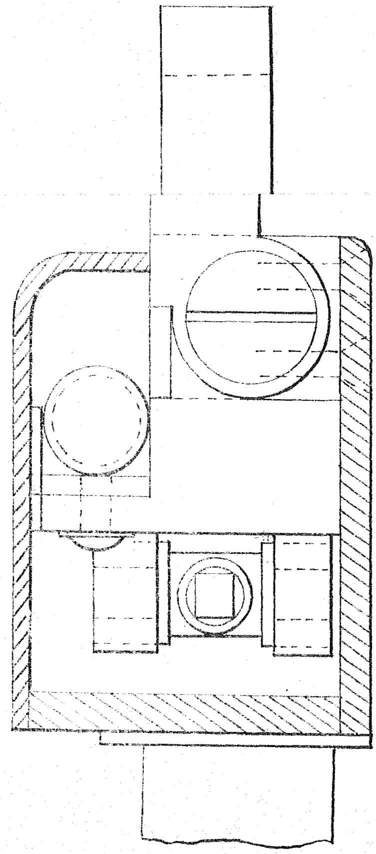


REVOLVING SIGHT FITTING INTO TANGENT SIGHT SOCKET.

FULL SIZE.

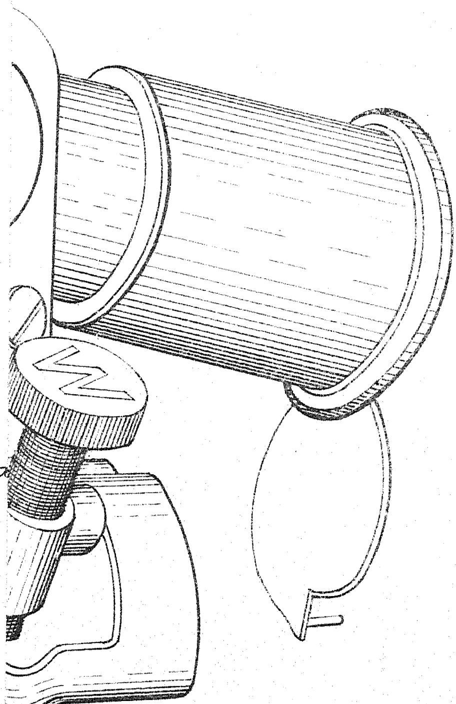


FRONT ELEVATION.



SIDE VIEW.

GUN.



NOTES
ON THE
STRATEGY OF OUR SMALL WARS.

BY

LIEUT. C. E. CALLWELL, R.A.

THAT history repeats itself is in no case more remarkable than in that of war. It is for this reason that military history forms the basis for the study of Strategy and of Tactics. Records of the past are valuable not only as affording precedents for the conduct of great operations; campaigns of minor importance also, and the movements of regular troops in lands far away from the centres of civilization, are elucidated by the examples of Commanders in former small wars.

In the "Operations of War" we find the broad rules that should guide the conduct of armies in the field deduced from the great campaigns of modern times, and a general knowledge of military science presented to the student. But the works of Hamley, Jomini, and other great exponents of the art of war, deal almost entirely with conflicts between trained and disciplined armies; they treat of combinations by strategists versed in the theory and practice of their calling, and depict theatres of operations intersected by railways and roads, where every movement can be determined by calculation, and where obstacles are but obstacles in appearance. Guerilla warfare, and campaigns where regulars, with all the resources of wealth and science at their command, are opposed to hordes of savages or bandits, and to the dangers of a tropical climate, receive scant attention; and references to struggles of this class, when they occur, are for the most part introduced merely to throw light on the course of greater events. Yet, of the many recognised principles on which modern Strategy is founded, some are wholly inapplicable to small wars, others require sweeping modification to meet altered circumstances.

Strategy, as a science, hinges on communications. How then can it serve to control operations against Maories or Afghans, who possess no communications and require none? A leader who ascertains that

his adversary's line of retreat presents no opening for attack, strives to break in between his detachments and to overwhelm them in detail; but the warriors of Zululand or Ashantee, their front pierced, have but to disperse and await a fresh opportunity for combined action.

The strategic aspects of the small wars on which our forces are frequently engaged, present at every turn features that have no place in continental warfare of recent date. The marches of Havelock and of Roberts—of armies cast loose in a hostile country, their communications deliberately abandoned, with no secure base to fall back upon if worsted, and with a hard pressed fortress as their goal, have no parallel in the wars of Napoleon or the Archduke Charles. The spectacle of an invader hemmed in within the territories of the enemy, a fate that befell Elphinstone at Kabul, and Sale at Jellalabad, and as occurred more recently at Ekowe, serves to show the doubts and uncertainties that surround the detachments of disciplined troops that have so often to uphold the interests of civilization against barbarism; and is a signal illustration of the change that takes place in the system of war when one side only moves on the lines laid down by science. The Cavalry descent on Cairo in 1882, and the prompt seizure of Kabul after the massacre of the Embassy, show clearly what may be expected from our men when circumstances demand a bold move in face of inferior *moral*.

Theatres of war exist where there are neither railways nor roads, where the rivers are unbridged, and where the mountain chains deny passage to wheeled Artillery; where the scanty population can supply neither commissariat nor transport, and where the General in command finds himself beset with dangers that are in no way due to the machinations of the enemy. To deliberately permit the divided forces of an adversary to concentrate, in view of delivering a crushing blow at the hostile army when assembled, would be to set at defiance established principles of war where the opposing parties fight on the modern system; but in irregular warfare such a course may be unavoidable. In the jungles of India and amid the hills that overshadow its frontiers, our chief stumbling block has often been found in the unwillingness of the foe to meet our forces in open battle.

Tactics decide what are but episodes in Strategy; and, while the cut-throat Pathan or fanatic follower of the Mahdi are, from a tactical point of view, no match for the trained soldier of Europe, Strategy is on the contrary entirely in their favour. Untrammelled by communications, requiring neither roads for their movements, nor magazines for the storage of war matériel, without commissariat, transport, or hospital *impedimenta*, they acquire a liberty of action that more than compensates them for the loss of initiative resulting from a defensive status. To meet them on even terms our Commanders are driven to shifts and expedients; Cavalry are converted into Camel Corps, and Infantry into Cavalry; equipments devised for temperate climates and regular military operations give way to others better adapted to the circumstances of the case; and the most superficial consideration of our recent campaigns will shew how altered is the whole system of war under these conditions.

Afghanistan.

Offensive Strategy admittedly confers on the assailant an advantage in leaving to him the initiative, but calls for ample resources and elaborate preparation, while the difficulties in the way of an invader multiply at every step in advance. The defenders on the other hand fall back amid their resources, can choose their line of retreat, and by destroying the roads, reserve the use of them for themselves, while depriving the enemy of their aid. In Afghanistan circumstances forced upon us the *rôle* of invader. Little benefit was derived from the possession of the initiative. The huge mountain barrier that separates the plains of India from the rugged and hilly territories of the Ameer, penetrated by but a few well-known Passes—Passes that have for ages been the highways of commerce and of conquest—left us few alternative courses of action. History has swept down on India through these gloomy defiles, mapping out their courses and defining their limits. The paths by which the British armies must advance on the capital were as well known to the Sirdars at Cabul as they were to the Indian Government at Simla. An enterprising and wary foe might have opposed the advance on every line; might have converted what was at times but a military promenade, into the desperately contested passage of a succession of defiles, and have necessitated a larger increase in the numbers engaged on our side. Oriental fatalism, however, combined with the intrigues and treachery that are ever rife amid the counsellors of an Asiatic potentate to bring about a policy of masterly inactivity, and to grant our forces an easy advance into the heart of the country.

Before selecting a theatre of operations, it behoves clearly to determine the object to be attained. In Afghanistan we had practically two objects in view—Kandahar and Kabul. The former situated at a great distance from the frontier, at the junction of several trade routes and, from the peaceable disposition of the surrounding tribes, easy of access, fell early into the hands of the British. Kabul lying in a fertile valley, but surrounded by lofty mountains, amid a warlike and fanatical population, and with but two roads fit for the movement of an army leading to it from the Indus Valley, proved a harder nut to crack. A small force was detailed to advance by the Kurum Valley, while the main body moved into the Jellalabad Valley by the Khyber.

The separation of an army in the field, as a general rule injudicious, is at times not only justifiable but even unavoidable in the invasion of a country. The Federals always moved into Virginia by several roads, to permit of their great armies advancing in effective order, thereby offering frequent opportunities to the brilliant strategy of their opponents: and the Prussians in 1866 were obliged for the same reason to operate on two lines. When circumstances forbid the combination of the entire strength of the defenders against one portion of the invading forces, this principle of advancing on several lines has much to recommend itself. Long columns are avoided, the strain on the military train is relaxed, the various detachments mutually protect each other's communications, and the moral effect produced on

the enemy by occupying wide stretches of the country must not be left out of account. The Sufeid Koh Range, dividing the Kurum from the Jellalabad Valleys must have proved a serious obstacle even to the Afghans, had their leaders sufficiently grasped the situation to aim at massing their forces first on the one side and then on the other. The nature of the country demanded an advance on the two available routes. So narrow and so restricted were the lines of operations, that even the small forces engaged must have lengthened out into columns of excessive length had the whole moved united on one road. A secondary object, moreover, of the campaign was the exploration of the mountainous tracts, adjacent to British territory, which could best be attained by the military occupation of the principal valleys. The possession of the Kurum basin proved of the utmost service, when, after a temporary cessation of hostilities, the massacre of Cavagnari's Embassy necessitated the seizure of Kabul.

The entry of Roberts' victorious army into the Bala Hissar, having pushed through from the Kurum Valley, was followed by the abandonment of the original line of communications on the Shutargardan Pass and the opening up of the Jellalabad route. This change of base may be compared with the action of Wellington when he transferred his base from Lisbon to Santander. Strategy is opposed to the principle of depending on a single line when others are available, but the communications of an army operating against an armed and hostile population are especially open to attack, and hence results a great distribution of force to ward off desultory attacks. In the invasion of Afghanistan a single line of communication, despite its drawbacks, was preferable to the serious waste of force that the maintaining of several lines must entail. The Kurum Valley was held by a strong Division throughout the war, so that, had the course of operations suggested such a movement, communications might have easily been re-opened in that direction.

The march of Sir D. Stewart's Division from Kandahar is an example of an army quitting its original base, and striking through the enemy's country in search of a new theatre. Kandahar, however, served as a secure point to retreat to in case of a reverse. When Sherman, crossing Georgia, abandoned Atlanta and his communications with the Tenessee, with the ultimate object of basing his army on the sea, no alternative remained to him but to advance; the coast, however, offered in his case, as did Kabul in the case of Sir D. Stewart, a haven of refuge and a fresh base. Kabul was evacuated simultaneously with Roberts' march for the relief of Kandahar—no line of retreat was left open; and, so far from aiming at a secure point, where stores of ammunition and supplies awaited his arrival, and whence communications with India were assured, the object was here the raising of a siege in face of a superior army flushed with victory, and supported by the entire population of the surrounding districts. The complete success that crowned this achievement tends to deprive the operation of much of its interest from a strategic point of view. Had the warlike and predatory hillmen, whose territories were traversed, hung on the rear of Roberts' Columns, or attempted to reverse the result of the action

at Ahmed Kehl by an onslaught in the open, considerable delay must have ensued; while the failure of Ayoub Khan to prevent the junction of the Kabul force with the garrison of Kandahar, heralded the disaster that befell his host in the action that ensued.

The Kabul river, rapid and treacherous, flowing through the Jellalabad Valley, is one instance of an obstacle parallel to a line of operations; it exerted, however, but trifling influence on the course of the campaign. Affording, as it did, scant protection from attacks in flank, a fact due to the remarkable facility with which the enemy were able to cross the stream at will, it nevertheless threw great difficulty in the way of flying columns sent across to chastise marauders. A bridge of boats at some point such as Jellalabad, held by our troops, would have proved of service.

The value of fortresses in certain eventualities receives a remarkable illustration from the Afghan war. The contemptible resistance of Ali Musjid, barring as it does the Khyber Pass, cannot, when we remember the weak armament of the fort and the nature of the garrison, be put forward as an argument against the use of defence works in such positions. The fort of Bard in 1800, Bitsch in 1870, and St. Nicholas in the Schipka Pass, have incontestably shown how greatly small works of this class may impede the advance of an army. Kandahar and the Sherpore cantonment, however, when they afforded protection to our armies at a critical moment, show fortresses, originally destined to secure the chief cities of a country against attack from without, harbouring an invader against attack from within. Both were occupied by the enemy without firing a shot, both served as a secondary base to the hostile forces for months, and both sheltered the invader, when, by a great combined movement, the Afghans strove to wrest their soil from his grasp. There is much that is instructive in this. The conqueror, owing his safety in the hour of need to the very ramparts that have been erected to arrest his progress, and, through their instrumentality, secured in the possession of the territories he has overrun, is an incident that has a bearing on Strategy nearer home. Napoleon—the magic of his name dispelled by the horrors of the Moscow retreat, his treasury exhausted, and the flower of his once invincible army left on the Steppes of Russia—yet, pivoting on the Elbe with its chain of captured German fortresses, long defied the coalition that his restless ambition had drawn down on him.

Scattered over the face of Europe are numberless obsolete fortresses incapable of withstanding a siege. These relics of the past can contribute little towards stemming the tide of modern invasion; they open their gates at the first summons, or, at best, surrender after some show of resistance at the earliest crash of bombardment: once in the hands of the enemy, however, they serve as hostile depôts, and may become rallying posts for the invader in case of a temporary reverse. A great place of arms of the Antwerp type may for a time secure the frontiers of a country after the collapse of its armies in the field, but its fall will render further resistance absolutely useless.

Requisition is recognized as the only system by which a great army of invasion can be maintained. In Afghanistan, the poverty of the

soil forbade our leaders to place reliance on the districts occupied as a source of supply. The requirements of the armies were conveyed at great expense along tracks impassable to wheeled traffic. Every movement was hampered by deficiencies of transport. In campaigns such as this, vigour and promptitude of action are the harbingers of success, and it is in these campaigns that rapid and decisive movements are most difficult to accomplish. Scarcity of water, a danger that little troubles a General on the Continent of Europe, controls every enterprise, and shapes the plans of the Commander more than do the dispositions of the adversary; and, although this last question entered but little into the calculations of the British General during the campaign next to be considered, our operations in Zululand were controlled by difficulties, as regards commissariat and transport, to an extent less only than in Afghanistan.

Zulu War.

A glance at the map shows that the colony of Natal forms with the Transvaal State, an obtuse re-entering angle bounding Zululand on two sides. An angular frontier of this description, where the territories of the assailant more or less enclose the theatre of offensive operations, offers great facilities for menacing the flank of the defenders and threatening their line of retreat. In 1866, the Italians holding the re-entering angle formed by the Mincio and Po, within which lay the far inferior Austrian army, might, by an advance from the lower Po, have severed the hostile communications with Illyria. The difficulties and risk involved in bridging the river are scarcely a sufficient excuse for the sacrifice of a most favourable strategic situation by the movement from the other side that terminated at Custozza. When, however, we bear in mind that the Zulus, to whom defeat simply meant dispersion in all directions, had no fixed system of supply, and therefore no communications, we see the angular frontier line deprived of its significance.

The plan of campaign at first adopted was the invasion of Zululand by three separate columns. One under Wood operated from the northern side of the angle; another under Pearson crossed the Tugela near its mouth; and the main body, under Lord Chelmsford, entered the hostile territory near the angle. The invasion of a country on several lines has been already commented on in the case of Afghanistan. The British forces detailed for the overthrow of Ketchwayo's army were so small that, as far as numbers were concerned, the whole might have operated on a single road. In this open country an enemy operating on interior lines against separate bodies advancing towards a particular point, could alternate his strokes with great effect, and the mobility of the Zulu impis added to the peril of the situation. But the British, although acting on the offensive, dared not leave Natal and the Transvaal unguarded; the long and exposed frontier line necessitated a certain separation of the forces.

Experience of great campaigns has proved that the defenders of an invaded country will seldom venture on dubious reprisals. In 1870,

the Germans left but insignificant detachments in the State of Baden, collecting their great hosts in the Rhenish provinces; and in 1815, the long Franco-Belgian frontier was defended by but a few Regiments of Militia, when Napoleon swooped down on the Sambre. Such dispositions would have been inadmissible in the Zulu war. Had Lord Chelmsford crossed the border with his entire force at Rorke's Drift, the very countries, for the security of which hostilities were undertaken, would have been at the mercy of a horde of daring and blood-thirsty savages, who, after carrying fire and the sword through the length and breadth of the land, would still have assembled to do battle before Ulundi. Yet assuming that each of the three columns that invaded Zululand was in itself strong enough to cope with the entire strength of the enemy in his own country, it follows that two of the columns acting on the defensive might have been weakened, and a portion of the troops forming them been transferred to the third and main column, which could then have advanced with considerable chance of success. The event showed how ill-adapted was the system of offensive operations, on several lines, to the circumstances of the case. One column came to a stand still, another was hemmed in and besieged within the invaded territory, and the third re-crossed the Tugela with the loss of half its numbers.

The second phase of the Zulu war presents little of strategic interest. The small forces originally destined to subjugate the country had swelled into a strong Division of all Arms, in face of which resistance was futile, although several actions were fought ere the Zulus would surrender to the inevitable. The invaders crossed the border at two points; but each column being in itself a match for the entire hostile army, a separation of force was judicious, owing to the moral effect that the approach of two distinct bodies must produce in the Zulu capital. The very desperation with which our gallant adversaries contested the advance contributed as much to bring about the pacification of the country, as did the skill with which the British forces were handled. The end for which hostilities were undertaken was not merely to parade the might of England before Ketchwayo's dusky host and to destroy the King's kraal; the object of the war was the complete annihilation of the Zulu military power; and the result was soon achieved when their impis rushed down on our troops in laager and in square.

Like the Cabul river the Tugela presented a strategic obstacle to us, but not to the enemy. The river protected the Zulu frontier; it cramped the movements of British columns in hostile territory, restricting their lines of communication and impeding transport, but its waters in no way hindered a counterstroke against Natal, as was shown during the onslaught on our part at Rorke's Drift. The constant difficulties, as regards transport, were small in some respects compared to what was experienced in Afghanistan. There was a sufficiency of grass for horses and cattle, the roads were passable for the great Cape wagons, and water was plentiful. Our lines of communication were short, and, except at Ekowe, the Zulus never committed themselves to enterprises in this direction.

Boer War.

The influence that the configuration of frontiers may exert on the course of a campaign, is well illustrated by our unfortunate operations in the Drackensberg. The northern part of Natal forms an acute salient jutting in like a wedge between the Transvaal on one side, and the Orange Free State on the other. The Boers, having shaken off British rule, having hemmed in such of the British detachments as they had failed to lure into ambush, and having assumed a threatening attitude on the borders of Natal, the burden of action and of assuming the initiative was thrown upon us. The delay that necessarily resulted before General Colley could take the field, enabled the Boers to cross into Natal and occupy a strong position within the angle barring the main road to Pretoria. An attack on this position of Laing's Nek miscarried, and the opposing forces remained facing each other.

That the advantage of the strategic situation was all in favour of the Boers became apparent with the development of the campaign. The acuteness of the angle in this case is in itself sufficient to attach great interest to the operations, viewed as an example of a salient and re-entering frontier line: but another feature enters into this question, which, arising from political considerations, has scarcely a precedent in the history of war. While both sides of the angle were open to the enemy, one was to us absolutely closed. Through gaps in the mountain chain that marks the frontier between Natal and the Orange Free State, the Boers poured down to harass General Colley's communications, bands of freebooters penetrated into the colony far south of where the British force was encamped, creating alarm in the capital itself; yet any demonstration in check of these incursions would inevitably have converted the partizanship of the neighbouring State into open hostility. The one-sided neutrality of the Orange Free State gave the issues on that side of the angle to the enemy, while political considerations formed the frontier into an impassable obstacle for us. The strategic situation of General Colley's column at Mount Prospect resembles that of the Austrians at Villa Franca, had Cialdini held the passages of the Lower Po in 1866; indeed, the acuteness of the angular Natal frontier, as compared to that formed by the Mincio and Po, renders Colley's position very much the more perilous of the two.

Laing's Nek is an instance of one case where the separation of an army in order to achieve a certain object is judicious. The Boer position was of exceptional strength; the transfer of the entire British force into Transvaal territory about Utrecht, would have betrayed at once the design of turning the enemy's left flank, and therefore, should such a manœuvre have been determined on, a containing force must have remained at Mount Prospect, while the remainder of the troops at disposal manœuvred to the right. Whether such a course would have been judicious, offering as it did a silver bridge for the enemy to withdraw without risking a decisive action; whether, in fact, the nature of our adversary did not call for a bold stroke—such as was Wolseley's assault of the trenches at Tel-el-Kebir—is a question that

could arise only in campaigns of this class. To hazard a frontal attack on an enemy in a strong position, which a strategic movement to the flank would render untenable, can seldom be justified in continental warfare. But with Boers, Afghans, and the like, an opportunity of inflicting a crushing defeat, even at the risk of suffering loss, should never be allowed to pass. If the issue can be decided by Tactics,—where superior armament, the bonds of discipline, and a well regulated chain of responsibility all concur to give our troops the advantage, it is surely unwise to leave the decision to Strategy, when all is in favour of the foe.

The small column with which General Colley undertook to clear the road to Pretoria was, as the event proved, quite unequal to the task.

The endeavour to re-open the several British communications with Newcastle, that brought on the unfortunate engagement near the Ingogo, may be cited as an instance of a Commander temporarily cut off in a hostile country, trusting to the troops under his immediate charge to extricate him from the dilemma, in place of waiting till the detachments in rear can gather strength and come to his assistance. Mount Prospect was not actually in hostile territory, but the configuration of the frontier rendered it practically so. Pearson at Ekowe, and Primrose at Kandahar made no effort to release themselves; and, when a sudden upheaval of the turbulent clans round Kabul for some days confined General Roberts' force within the cantonments of Sherpore, the duty of clearing the line between the main body and Jellalabad devolved on General Gough's Brigade. This seems the wiser course to pursue. A retrograde movement of the whole, amounting to a confession of inferiority, is in small wars inadmissible. The detachment of a portion of the force, with a view to re-open communications, is a movement of separation with its attendant dangers. On the whole, then, as long as the force cut off is in no distress as regards food or ammunition, and always supposing reinforcements at hand, there are strong reasons in favour of waiting the course of events, and leaving the solution of the difficulty to other hands; if, however, co-operation between the troops cut off and those coming to their relief be feasible, the two forces should work together.

The Buffalo river is, in the influence it exerted over this campaign, a signal illustration of an obstacle parallel to a line of operations. Rising but a few miles north of Laing's Nek, but, like most South African rivers, rapidly changing from an insignificant rivulet into a deep and muddy stream that flows sullen and unfordable between the high banks scooped out by its waters, it became a military obstacle as it quitted the country held by the Boers—but not till then. Thus, the Boers could operate along either bank at will, while Colley's force was confined by the river to the Natal side, except at a few well-known drifts, which at that season were often impassable. At the same time, having no troops at his disposal for watching these passages, the obstacle afforded no protection whatever to the General's flank, nor security to his line of communications.

Egypt.

In selecting a theatre of operations, there are many points to be considered[1]—the proximity of the object; the position of the enemy's forces; the security of the base; the existence of good roads to the object; and the suitability of intervening country to military operations.

In the Egyptian war of 1882, the command of the sea-board accorded us by the guns of our Fleet, coupled with the seizure of the Suez Canal, rendered the possession of the initiative, offering as it did so many alternative courses of action, of the utmost advantage to our side. A landing could have been effected at almost any point between Alexandria and Suez. Alexandria, a great maritime city, provided with all appurtenances necessary for the disembarkation of an army, and in every way fitted to form a base of operations, was already in our hands. Cairo is about the same distance from Alexandria that it is from Rosetta, Damietta, and other ports on the Mediterranean Coast. Ismailia is some miles nearer by road and rail; and Suez is, by the caravan route across the Desert, nearest of all. In arranging a plan of operations, Alexandria would at once suggest itself as a base. As regards proximity to the object, the line from Alexandria to Cairo was certainly one of the shortest; and a good road, supplemented by a railway, would in this theatre lead from the base to the object. But the position of the enemy's forces offered a great impediment to advancing by this line; the lines of Kafr Dowar, in which lay Arabi's main strength, barred the way; and the restricted nature of the country denied passage round the hostile flank. Moreover, the intervening country was at this time of the year, owing to the Nile inundations, entirely unsuitable to sustained military operations. By a descent on some other point of the Mediterranean Coast, the hostile forces might for a time be avoided, but the unsuitability of the intervening country remained; no port existed that could compare with Alexandria as a base of operations, and by using the railways at their disposal, the Egyptians could rapidly mass their troops on the threatened line. By the bold stroke of transporting the British expedition from Alexandria to Ismailia, landing a small force at that point to press forward and secure as much of the Canal as possible, before the enemy should arrive on the spot, and, under cover of this Advanced Guard, disembarking the main body at this nearest point to Cairo, except Suez, Lord Wolseley took the enemy by surprise, secured a good base of operations, combined with the Indian Contingent, and occupied a considerable extent of country in a theatre where the sustained movements of an Army were feasible. Nothing could more clearly demonstrate the advantage resulting from the possession of the initiative than the spectacle of a mere handful of our troops pushing up to Kassassin, while the mass of Arabi's forces were engaged in watching Wood's containing Brigade before Kafr Dowar.

The Egyptian campaign gives a good example of the effect of an angular frontier. Wolseley's advance towards Tel-el-Kebir threatened

---

[1] Hamley.

the communications of every hostile detachment in the Nile delta. The fine march of the Indian Contingent from the battle field to Zagazig paralysed the Egyptians near Alexandria, as well as the scattered bands about Damietta, and led to their speedy submission. On the other hand, had the blow fallen from the side of Alexandria, the advance on Cairo would have necessitated the abandonment by Arabi of Ismalia and other points on the frontier, on pain of losing the troops there stationed. While the British operations along the Fresh Water Canal directly menaced the enemy's line of retreat, our communications with Ismailia were directly covered. Any attempt on the part of our adversaries to sever our Advanced Guard about Kassassin from their base on the Canal, must have exposed the flank of the troops making it.

A descent on the coasts of a hostile power presents one noteworthy feature as compared with an invasion when the rival frontiers are contiguous. The assailant is spared the anxiety and the waste of strength entailed by the necessary defence of his own territory. Thus, while of the 300,000 men believed available for the invasion of Germany, 50,000 were in Napoleon III.'s plan of campaign detailed to remain at Chalons, as a guard for the French frontier; the entire allied Army was transferred from Varna to the Crimea, counter attack on the part of the Russians being out of the question.

An army operating from the sea possesses great latitude of action in a country whose coasts are adapted for landing troops. The opening of hostilities from the side of Alexandria, followed by the change of base to the Suez Canal, under the veil of an imaginary, but by no means impossible attack on the Aboukir Forts; the landing of Indian troops at Suez and other places on the line to Ismailia; the subsequent arrival of the Highland Brigade, originally detained about Ramleh, but transferred by sea to the scene of action as the British plan of campaign developed, all show the value of maritime ascendency over a power whose coasts it is proposed to assail. General Graham's operations on the Red Sea littoral furnish another remarkable instance of this in the temporary change of base from Suakin to Trinkitat.

Discussion as to the strategic aspects of this second phase of the Egyptian war is sensibly narrowed by the uncertainty that prevails as to the aim of the expedition. The topographical nature of the theatre of operations dictated the small proportion of guns that accompanied the force, although the value of the Artillery Arm in a struggle with warriors such as fought under Osman Digna's standard can hardly be overrated.

Obstacles are generally classed under two heads,—mountains and rivers. Forests and morasses, both obstacles from a tactical point of view, are seldom of an extent sufficient to materially affect the plans of a campaign. In Egypt, however, we find the deserts furnishing a strategic obstacle not generally treated of by military writers; an obstacle that exerted an all-powerful influence over the strategy of our recent operations in the country. During the campaign of Tel-el-Kebir, the British troops were, in their advance along the tract of cultivated ground bordering the Fresh Water Canal, confined on either side by deserts to this narrow strip, known as the Wady Tumilat: and Arabi

was thus enabled to throw up a series of entrenchments, and await attack in a selected and prepared position. The Desert forbade an advance on Cairo from Suez, a port well adapted for a base of operations, and situated at the nearest point to the capital on the entire coast line. The Desert between Suakin and Berber places an obstacle so serious in the way of an army endeavouring to gain the Upper Nile from the Red Sea, that it was deemed advisable to withdraw General Graham's victorious force, when an opportunity appeared to exist of taking pressure off Khartoum. For a desert to form an obstacle, in the strategic sense of the word, it must be of considerable lateral extent. A mountain chain may be a mere ridge of lofty hills of but a few leagues width at the base, and yet form an element of the utmost importance in deciding strategic issues; an insignificant stream, unknown to the Geographer, may, as long it is for some considerable part of its course unfordable, form a pivot for the manœuvring of great armies in the field; but a mere belt of desert would be insufficient to exert such an influence on the plan of operations. Like other obstacles, a desert limits an army on the offensive to a few well-defined lines, delays its progress, and adds to the difficulty of maintaining its system of supply from its base; it, however, in no way forms a curtain, behind which the assailant can collect his forces, and, when all is ready, swoop down on an unexpected quarter. The reconnoitring parties of the defender can cross the desert at will, and watch every movement in advance.

In the Egyptian war of 1882, our opponents were operating on "interior lines." To take advantage of such a situation, a containing force should be placed on each line which the invader appears to threaten, and the main body held ready to join whichever wing sustains the brunt of the attack. Arabi left a containing force at Kafr Dowar, and massed his forces at Tel-el-Kebir. But as the British plans developed, he should have weakened the force left facing Sir E. Wood to the utmost extent possible, so as to strengthen his Army at the decisive point. A mere detachment would have sufficed in the lines of Kafr Dowar. The railway system of the Nile delta lent itself readily to the concentration of troops; and that but a portion of the available Egyptian strength was collected for the decisive battle, argues an entire failure to grasp the situation on the part of Arabi and his Staff.

General considerations.

The rapid march of events, and the suddenness with which lasting results are achieved, is one leading characteristic of the great wars of the present epoch. Napoleon's most brilliant campaigns were decided in a few weeks; the succession of reverses that in 1870 laid France at the feet of Germany, followed each other with startling rapidity. In operations of minor importance, however; in irregular warfare; and in campaigns where trained and disciplined armies have been engaged in quelling rebellions, or coercing insignificant and defenceless Provinces, the development of events is more prolonged. The efforts

of the French to subdue the hardy mountaineers of the Tyrol form a marked contrast to the glories of Ulm and Austerlitz that immediately preceded. The Russian Armies only quelled the Polish insurrections after months of desultory fighting; the chequered fortunes of the Austrians in Bosnia and Herzegovina, and the indecisive and uninteresting operations that recently took place in Tunis, are further instances.

The delay that has attended many of the small wars of the past decade is often attributable to the geographical features of the scenes of conflict; but in Afghanistan, Zululand, and elsewhere, causes other than those arising from the topography of the theatre of war forbade brilliant and expeditious operations. Strategy—plastic under the touch of genius—loses in the hands of the guerilla and the savage that consistency that has enabled the art of war to assume a definite shape. The General opposed to adversaries such as these finds his calculations set at nought, and his most skilful combinations shattered by the inability of the foe to grasp their meaning; he possesses the initiative, but his opponents refuse to conform their movements to his, and hence results a tedious and harassing campaign. The contrast in this respect between our operations amid the hill tribes of Afghanistan, and the swift and decisive strategy that brought about the collapse of the Egyptian rebellion is remarkable, as accentuating the difference between an armed hostile population and the opposition of a regular, if cowardly, army under scientific leadership.

History furnishes many instances of the decision of great issues by the seizure of the capital of a hostile country. The consequences that arise from the fall of the chief city, containing, as is so often the case, the seat of Government, will greatly depend on the relations between itself and the country. If the capital be the centre of wealth and commerce, the axis whence the great highways radiate, and the recognized seat of power, the results of its occupation by a foreign army will exert a momentous influence on the campaign. If, on the contrary, the capital be merely an important town disregarded beyond its immediate surroundings, destitute of associations, and the residence of a mere nominal ruler exercising his feeble sway on an aggregate of tribes that scarcely acknowledge his authority, its seizure offers to the invader no guarantee of success. The storming of Delhi, the historic capital of India, and the focus of sedition and intrigue, proved a death blow to the Mutiny, although the fall of Lucknow, of almost equal importance, was required to re-establish British supremacy. The victorious march to Pekin was speedily followed by peace. During the second Sikh war, on the other hand, when our armies were opposed to a nation in arms without a government and without a head, the possession of Lahore, from the very outset, was of little avail. The capture and destruction of Coomassi and of Ulundi, each the chief place of a despotic monarch, stamped out all vestige of opposition; while with the occupation of Kabul and Kandahar, our difficulties in Afghanistan were but commencing. It is questionable if the successful march of a British column to Pretoria would have brought about a cessation of hostilities in the Transvaal.

It is but of late years that the press has become an element that must not be overlooked in military operations. The interests of the war correspondent are at variance with the interests of secrecy. Inasmuch, however, as representatives of journalism are as a rule to be found on both sides, they, in a manner, neutralise each other. In small wars, when the correspondent is restricted to the side of the regular troops, the mischief resulting from indiscreet disclosures is greatly diminished by the ignorance of the foe. Thus, the war news that daily appeared in all parts of the world can have little assisted Afghans or Zulus in their calculation of possible contingencies. During the Boer war, on the contrary, the Natal press must have kept the enemy acquainted with all that was passing. The position of every detachment was noted, and the arrival of every ship chronicled with a regularity and accuracy fraught with danger to our cause. The translation of these effusions by some educated Boer, for the benefit of his comrades, no doubt served to wile away many a weary hour round the watch fires on Laing's Nek. On the other hand, no reliable information as to the doings of our adversaries leaked out through the newspapers; the Transvaal journals such as they were, were under control of the Boer triumverate, who discouraged the presence of press representatives in their camp. The cream of the war correspondence in the London dailies no doubt often percolated through to Cairo during the Egyptian war; but owing to the judicious censorship established, the information thus obtained can have been of little value. The courage, the abilities, and the self-denial of the race of British war correspondents that has sprung up of late years, are beyond dispute; but the losses sustained in their foremost ranks, and their great services to the reading public, should not blind us to the fact that their presence cannot, from the military point of view, benefit an army, and may be prejudicial to its success.

The influence of climate is more observable in the small wars of the tropics than in the great campaigns of Continental Europe. In the temperate zone rain damages roads and impedes a rapid progress; and in certain campaigns, notably in the Crimea, cold has worked terrible havoc among troops; still, the effect of rain and cold on Strategy is far inferior to that of the sun, with its attendant evils of fever,—and bad water further south. At certain seasons, campaigning is, in the tropics, almost out of the question. Unfavourable climates breed disease, an enemy far more formidable than the rude warriors that people their lands. Sunstroke decimated our armies during the Indian Mutiny; the treaty of Gundamuk, preceded by a well nigh bloodless campaign, was followed by a disastrous retreat in face of cholera, a foe whose onset the rear guard was powerless to withstand, and from whose deadly clutches forced marches offered no escape.

The dangers that arise from the separation of armies in the field are universally recognised; but never perhaps is such a course more perilous than in a contest with adversaries whose movements it is impossible to watch, and whose concentrations it is impossible to foresee. The unexpected uprising of the tribesmen round Kabul, almost theatrical in its suddenness, found the Brigades of the Sherpore force engaged on

detached expeditions, and thus placed the cantonments in some jeopardy. The retrograde movement of a part of General Colley's force at Mount Prospect, led to the disastrous engagement near the Ingogo; and the defeat of the British detachment at Majuba Hill, within sight of the main body in camp below, is a remarkable example of the evils of separation. The expeditionary force to Egypt was broken up into two bodies, one in Alexandria and the other operating from Ismailia; but here there were approved grounds for separation: it was essential to secure Alexandria. Sir E. Wood's force contained a very considerable part of Arabi's army in the lines of Kafr Dowar, and even had this not been so, the two Divisions that attacked Tel-el-Kebir, could have successfully coped with the entire strength of the rebels. In this last respect the case resembles that of the final invasion of Zululand on two separate lines.

There are found in every theatre of war certain points, the possession of which, by either side, is in itself a step on the road to success. These "strategic points" are, as a general rule, at the passages over some obstacle, or else at the junction of roads or railways, and are, on the Continent of Europe, marked by fortresses or defensive works. Kabul, at the meeting place of several valleys, possesses a military importance beyond that of being a great centre of Asiatic commerce and wealth. Kandahar commands the great highway to Herat and the disputed territories beyond, as well as the road to Ghuzni, and covers the defiles leading from Afghanistan into Scinde. Berber, at the point where the great water way of the Nile meets the caravan route leading to the Red Sea, is a good instance of a strategic point, as is Zagazig, commanding the railways to Ismailia, to Alexandria, and to Cairo. Viewing Natal as a theatre of operations directed against the Transvaal, a glance at the map demonstrates that the geographical features of the country where the tributaries of the Tugela flow in parallel lines from west to east, present certain difficulties to an army advancing northwards. These streams, insignificant in volume, are nevertheless deep and sluggish, and almost impassable except at the drifts which are few and far between. Each drift thus becomes a strategic point of more or less importance. In the course of a campaign, moreover, certain points will assume an adventitious importance from the situation of the forces in the field. Such was the case at Plevna in 1877. Laing's Nek is another example: had the Boers remained within the borders of the Transvaal, there would have been little in this horsehoe of hills to point it out as a strategic pivot; yet the course of events converted it into the axis on which hinged the Drackensberg campaign.

A combination of Defensive Tactics with Offensive Strategy will seldom recommend itself to the General undertaking the invasion of hostile territory in the course of a great campaign. The circumstances that warrant the assumption of the offensive in Continental warfare being, numerical superiority, an organization more perfect than that of the adversary, or, remarkable facilities for the massing of troops at the point of aggression, the Strategist so shapes his plans as to assure superiority at the moment of collision; and this superiority the

Tactician turns to account by maintaining the initiative and delivering an attack. Defensive tactics argue inferiority in numbers, in training, in armament, or in *moral*. The Germans on the Lisaine acted on the defensive, as did the Russians in the Schipka Pass; and at Brienne, Montmirail and Craonne, Napoleon covering the approaches to Paris struck at the invading hosts. Yet as a general rule the initiative strategically will necessitate offensive tactics. In "partisan" warfare, on the other hand, the trained and disciplined army, from the nature of things obliged to penetrate into the enemy's country, is, as regards numbers, far inferior to the huge array that fanaticism or patriotism will bring together to dispute the advance: its very perfection of organization serves to hinder rapid movements, and to thwart vigorous strategy. The facilities, moreover, offered by railways and roads for sudden concentration, are as nothing when contrasted with that unaccountable influence that draws together myriads of warriors to some chosen ground, and permits them to disperse and disappear when their task is completed, or their design has miscarried. And so the small but self-reliant force, hedged in on every side by unknown dangers, ever dwindling as detachments drop off to secure the all-important communications, ignorant of the strength, the intentions, and the whereabouts of the foe, moves slowly forward to attain its object,—till of a sudden the enemy is descried, a position is selected, and the hostile swarms swooping down, confident of victory, are hurled back by the insignificant but resolute band.

No amount of strategic skill can alter this. The invader will inevitably arrive on the trysting ground weaker than his opponent, and must act accordingly. Hence results a defensive attitude when in contact with the enemy, without marring the offensive plan of campaign. Ahmed Kehl, Ulundi, Tamai, and the engagements that have recently taken place on the road across the Bayuda Desert, are all instances of armies moving forward with a definite object into the heart of an enemy's country, standing to receive the hostile attack, and resuming operations when this has been disposed of.

The difficulty of maintaining communications, demanding as it does the adoption of exceptional precautions, exerts a very remarkable influence on the Strategy of small wars. Not only must the invading army be so disposed in the theatre as to forbid a descent by the mass of the adversary's forces on the lines leading towards the base; but the utmost vigilance must also be exercised, and an especial arrangement of defensive posts must be established, to check the enterprises of marauders against convoys and detached parties. Garrisons for these defensive posts are a great drain on the numerical strength of the invader. In struggles between civilised nations, the inhabitants of districts overrun by the enemy's troops, however incensed they may be against the intruders, dare not, in face of the stern measures sanctioned by the laws of war, molest their movements, or even give expressions to their feeling of hostility. Where, on the contrary, there is no regular army or military system, the entire population may take up arms in defence of their country; each individual acts for

himself, and, if taken in *flagrante delecto*, is entitled in a manner to be treated as a soldier. The communications of an army when they traverse hilly regions infested with lawless tribes; or when carried through a country whose inhabitants maintain their neutrality, only as long as a sufficient force be at hand to overawe this spirit of enmity; are a constant source of anxiety and of weakness. Roads are broken up, telegraph lines cut, stragglers are slaughtered, and to minimise the mischief, a very large proportion of the available force must remain behind in positions where for purposes of Offensive Strategy they are entirely thrown away. An immense force was, during the Afghan war, maintained in the Jellalabad Valley and along roads leading from Kandahar back to the Indian frontier, more than two-thirds of the entire army being in fact on the lines of communications. In 1809, scarcely half of Napoleon's host, and that the worse half, held the huge stretch of country from Vienna to the French frontier. While, after the fall of Metz, huge German armies were massed round Paris, or engaged on detached operations on the Loire and elsewhere; but a fraction of the forces they had placed in the field guarded the roads leading to the Rhine. This question of waste, arising out of long lines of communications, through tracts peopled by turbulent and lawless races, or through a country where the feeling of the population is intensely hostile, may to no small degree influence great operations between the armies of civilised powers. During the Peninsular war the French were harassed at every turn by the Spanish peasantry, a fact that largely contributed to bring about their final expulsion from the country. The Austrians, striving to maintain their grasp on Northern Italy, dared not use the roads leading along the front of the Alps as a line of communication, owing to the disaffection existing in the hill districts.

The ever deepening shadow on the Afghan hills points towards eventualities that may call for operations in that country, far more extensive and hazardous than the campaign of 1878–80. The course that under such circumstances the wild nomad tribes, nominally owing allegiance to the Ameer, would pursue, is a matter of grave doubt; and no stronger argument could be put forward in support of an advance to the Helmund than the saving of troops (on the communications) a firm grasp of the country up to that point would ensure.

Frederick the Great once declared that but for the misery he would bring on his people he would always make his own country the theatre of war, "for then every inhabitant is a spy, and it is impossible for the enemy to take a single step unknown." This remark well illustrates the difficulties of offensive operations in a country like Afghanistan, where circumstances combine to render the possession of the initiative of little avail, but where every movement of the invader is at once known in the bazaars and cities.

A thorough appreciation of the modifications in the system of war that the nature of the antagonist demands is, in minor campaigns, the precursor of success. There is but little scope for brilliant and decisive Strategy. Progress is slow, and collisions with the adversary

produce no important result. It is the moral effect of the spectacle of a trained and organized army thrusting itself forward, slowly but surely, into their territory that brings about the downfall of a barbarous or semi-civilised people. Each joint in their chain of communications protected by a fortified post, their transport adequate, and their supplies secure, the disciplined troops can advance with assured steps into the *penetralia* of the foe, can seek out the robber in his lair, can root out and trample under foot all spirit of opposition; and, finally, establish the supremacy of civilization in whatever part of the globe they may be called upon to act.

AN EXAMPLE IN
ANCIENT MILITARY LAW.

COMMUNICATED BY

THE SECRETARY.

[The following curiosity in Military Law was kindly lent to the Institution by Sir Henry W. Gordon, K.C.B.—*H.W.L.H.*]

PROCEEDINGS OF A REGIMENTAL COURT-MARTIAL HELD BY ORDER OF MAJOR-GENERAL RAMSAY, COMMANDING THE TROOPS.

Woolwich, October 11th, 1810.

Captain Rogers, Royal Artillery, *President.*

Members.

Lieutenants Geo. Baynes; J. C. Burton; T. Thompson; Geo. James.

The Court being duly sworn proceeded to try Gunner William Walkinshaw.

Crime.—Gunner William Walkinshaw, of Captain Roberts' Company, 10th Battalion, Royal Artillery, confined by order of the Commanding Officer for absenting himself from Woolwich (without leave) on the 24th November, 1809, and not returning until brought back by an Escort on the 8th October, 1810.

The crime, as above stated, having been read to the prisoner, Gunner William Walkinshaw, he pleaded Guilty to the same, and begged the mercy of the Court.

Sentence.—The Court is of opinion that the prisoner, Gunner William Walkinshaw, is guilty of the crime laid to his charge, being in breach of the Articles of War, and does therefore sentence him to receive five hundred lashes in the usual manner.

T. ROGERS,
Captain 3rd Battalion, Royal Artillery,
President.

Approved,
JOHN RAMSAY,
Colonel and Major-General,
Commanding the Troops.

Corporal punishment commuted to turning over Gunner Walkinshaw to His Majesty's Navy.

Received on board the "Thistle," Flag-ship, Woolwich, 13th October, 1810.

H. W. GORDON,
Lieut. and Adjutant, 10th Battalion, Royal Artillery.

WAR SERVICES

OF THE

ROYAL REGIMENT OF ARTILLERY.

COMPILED BY

MAJOR H. W. L. HIME, R.A.

The size of this contribution necessitated its separate publication. The numerous inaccuracies and omissions that may be found in it are not the result of carelessness, and only show the great difficulty (if not impossibility) of such a Table being made out by one person. The faults would have been more numerous but for the kindness of the D.-A.-G. in giving me access to the Record Office, and the invaluable and untiring assistance of Capt. R. H. Murdoch, Asst. Superintendent, R.A. Records.

As to War Services in the past, the materials for tracing them are, in most cases, here. But there is much difficulty about recent War Services—say during the last 25 years; and those interested are requested to correct the List and return it here. The notes of interrogation are not used to throw doubt upon past services; but are used to ask for further information. For instance, "Crimea?" is merely a request for further information as to a Battery's service there.

Woolwich,
May, 1885.

RO

THE
The
not
not
fau
D.-
and
R.A

A
in
Se
req
gat
to
req

PRÉCIS
AND
TRANSLATIONS.

FRANCE.

I.

REVUE MILITAIRE DE L'ETRANGER.
15th NOVEMBER, 1884.

BY

MAJOR J. H. G. BROWNE, R.A.

The Horse Artillery Question in Germany.

Among military questions, always so eagerly discussed in Germany, that of the organization and service of Horse Artillery, has been of late years the object of the most numerous studies. Several of the opinions put forward are contradictory upon many points, and it is difficult to deduce from these discussions what would be the nature of the re-organization of the Peace establishment, if the Minister at War thought it necessary, and what will be the distribution of Horse Artillery Batteries in time of War. At the same time, we can arrive at some conclusions with regard to the solution which might be applied to certain parts of the question.

The Artillery of the Guard, like that of each of the eleven Prussian *Corps d'Armées,* and of the Bavarian *Corps d'Armées,* comprises Horse Artillery Batteries attached to the Regiment of Corps Artillery. The Artillery of the Saxon Corps has two of them; that of the Bavarian Corps and of the Hessian Division, one only. The Wurtemburg Corps and the 15th Corps (Alsace Lorraine) have none of them. There is a total of 46 Horse Artillery Batteries for the whole of the German Empire.

The "*Revue*" gave an account, at the time of its appearance, of an essay which attracted a good deal of attention, and which treated of the separation of Horse from Field Artillery, The author considered whether the Peace organization of Horse Artillery Batteries is calcu-

lated to facilitate the development of the qualities which are peculiar to them, and their preparation for the *rôle* which ought to be assigned to them in War: whether the Peace organization permits them to call these qualities into play, and to fulfil this *rôle*. He concluded by demanding the formation of independent "*Abtheilungen*" of Horse Artillery.

In order to utilize upon the field of battle the mobility and the manœuvring powers of Horse Artillery Batteries, it appears to him necessary that they should not be engaged, at the beginning of the action, in the deadly combat which the Corps Artillery have to sustain; it is necessary that they should be always ready to move rapidly and for any distance towards the flanks menaced by a turning movement. They would constitute, so to speak, a reserve, which, in order to remain intact, should be independent of the authority of the Commandant of the Corps Artillery. Their *rôle* in a campaign is then different from that of Field Artillery, and their direction requires special aptitude and qualities; why then should they be joined in Peace time to Batteries from which they ought to be separated in War time? Why give the same Chief and a similar instruction? These arguments have been often repeated. But if opinions are nearly unanimous on the employment of Horse Artillery Batteries, it is not so with regard to the organization which should be given them.

Is the actual number of Horse Artillery Batteries which Germany possesses too few or too many? We find in a paper published at Karlsruhe in 1882, a comparison between the Horse Artillery Batteries of the principal European Powers. The author lays down that the proportion of Horse Artillery Batteries for every 100 Field Batteries is as follows:—

England	36 per 100
Austria	23 "
France	21 "
Russia	21 "
Germany	15 "

Be it understood that we leave to the author all the responsibility of this calculation, the inaccuracy of which is evident, only retaining his conclusion, which points to an augmentation in the German Horse Artillery.

Several writers, in their re-organization projects, are on the contrary led to demand either the conversion of part of the Horse Artillery Batteries into the Field Batteries, or a simple reduction. In their view, Horse Artillery ought to be the support of Cavalry, to operate with it, and to possess, on the Peace footing, an organization which permits them to be mobilized as rapidly.

Under this idea, the anonymous author of an article in the *Neue Militarische Blätter*, establishes a complete plan of re-organization. He has belonged to Horse Artillery for many years; he has a "predilection" for it; and, like most of the officers who are devoted to that service, he claims its independence. He wishes that it should be ready to be put upon the War footing at the same time as the Cavalry,

from the first day of mobilization; and he believes it impossible that a Battery with only 4 guns on the Peace footing, and with only 28 draught and 52 riding horses, including the "*Kriemper*," can be raised with sufficient celerity to a strength of 114 draught and 101 saddle horses. All the Batteries intended for Cavalry Divisions should have at least 6 guns in Peace time.

To arrive at this result without increasing the charges of the State, it would be sufficient to preserve the number of Horse Artillery Batteries strictly necessary for the independent Cavalry Divisions, to turn the others into Field Batteries, and to transfer to the Horse Artillery Batteries retained, the horses rendered available by the transformation of the others.

The author would attach only two Batteries to each Horse Artillery Division; and proposes the formation of five Regiments of two "*Abtheilungen*" of two Horse Artillery Batteries each, so as to be able to attach an "*Abtheilung*" to each Cavalry Division to be formed, and to keep, perhaps, at the same time, some Batteries which might be employed later for new formations, and serve up to then as Reserve Batteries.

Each of the Batteries would have the following composition :—

	1	Captain-Commandant of Battery.
	1	First Lieutenant.
	3	Second Lieutenants.
Total, Officers ...	5	
	1	Wachtmeister.
	1	Vice-Wachtmeister.
	1	Portepee-Fähnrick.
	4	Sergeants.
	10	Corporals.
	3	Trumpeters.
	6	Obergefreite.
	10	Gefreite.
	86	Gunners.
	1	Farrier.
Total, men ...	123.	
	42	Draught horses.
	74	Riding horses (not including 11 Officers' horses).
	3	Kriemper.
Total	119.	

The number of horses would thus exceed that strictly necessary to draw six guns, which would allow "that the youngest horses should be rested during Battery manœuvres, and that the oldest horses and those least fitted for war service should be placed in the Reserve; so that the Combatant Battery would go under fire only with trained and good-conditioned animals."

A special inspection would be instituted for the Horse Artillery Regiments.

This organization would leave about 1500 horses disposable, which would more than suffice for the creation of 26 Field Batteries intended to replace the reduced Batteries of Horse Artillery.

But we know that the German Artillery, pushing its respect for the principle of service by Battery to its furthest limit, never manœuvres with wagons; and that, at the very outside, 4-gun Batteries are raised to 6 guns two or three times, either during the gunnery courses or towards the end of the Battery manœuvres; sometimes, also, during the exercises on varied grounds, Battery echelons are represented by one or two carriages. There is evidently something wanting in this mode of instruction; and the wish has often been expressed in Germany, that it should be possible to manœuvre Batteries frequently with six pieces, and that echelons should be represented during Autumn Manœuvres and regimental exercises.

To satisfy this wish, the officer, whose projects we have analysed, proposes to create for each "*Abtheilung*" a section whose strength would correspond with that required for two guns, and which would be at the disposal of the Commandant of the "*Abtheilung*." This officer would join it to each of his Batteries in succession, either to raise them to six pieces, or to enable him to represent each of the echelons by a single carriage. This section, in case of mobilization, would form the nucleus of a new Battery.

This proposition, which has at any rate the merit of being original, is a new indication of the aspirations of the German Artillery. It is, under a new form, the incessantly renewed demand for the increase of the military forces of Germany.

At the end of an article upon "The employment of Horse Artillery attached to Cavalry," a Bavarian officer, referring to the augmentation of the strength of Horse Artillery, and believing it useless to attach Horse Artillery Batteries to Corps Artillery, proposes to reduce the six Horse Artillery Batteries, which the Bavarian Artillery actually contains, to four.

Each of the new Batteries would comprise 42 draught and 78 saddle horses; giving for the Batteries a total of 480 horses, a number equal to that of the horses of the six existing Batteries.

These four Batteries would form a Regiment. At the time of mobilization, three of them would be joined to the Cavalry Division, under the orders of the Commandant of the Regiment; the fourth Battery would not be mobilized, but would act as a Depôt and Reserve Battery, would receive, like a Cavalry Depôt Squadron, the horses of the mobilized Batteries unfit for undergoing a campaign, and would replace them by horses fit for service.

In the projects of which we have spoken, there are two very different opinions upon the number of Batteries which ought to be attached to a Cavalry Division. It is one of the points in question of which the discussion is always open in Germany, and the official solution of which is not known, because Cavalry Divisions are not organized in Peace time. At the same time, it would appear that the author of the first project, previously analysed, in fixing the number of Batteries to a Division at two only, was influenced by the organization which was

adopted at the end of the War of 1870. He brings forward no argument in support of the formation which he selects.

In the article upon the "Employment of Artillery," which we have quoted, the author, on the contrary, declares for attaching three Batteries to each Division—

"If a Division," he says, "forms the centre or wing of our line of exploration, it will employ the formations prescribed by Von Scherff and Von Schmidt." In the forward march, two Brigades will follow two parallel routes, with an interval of about four[1] miles; one regiment pushing two or three Squadrons to the front as first echelon, the other marching united a quarter of a mile in rear. The third Brigade will march in reserve upon the principal route. But, it is asked, how will the Artillery be distributed, and how many Batteries is it necessary to have?

The following rules are laid down:—

"If the Division marches upon one road only, a Battery will generally be attached to the leading Brigade. If the Division marches upon several roads, it will generally be by Brigades. The Commandant of the Division will give orders upon the subject of the distribution of the Artillery."

In the last case, the Commandant of the Division will adopt a formation of march analogous to that which is indicated for the first case; he will attach a Battery to each of the Brigades of the first line. The following example shows the necessity of it:—

A Squadron of the first line encounters the enemy in occupation of a defile; the defile appears occupied by Infantry or by dismounted Cavalry. The Commandant of the Brigade has two means of forcing the defile, turning or attacking—the first requires time and is always doubtful. The Commander determines to attack. The Battery goes to the front, discloses the position of affairs by means of some common and shrapnel shell, and soon forces the enemy to evacuate the defile. Under the most favorable circumstance, the Cavalry would only have succeeded after having fought on foot for whole hours. What would have happened if this Brigade had not had the necessary Battery on the spot, and if the Artillery had been with the Reserve?

Even if we consider that the total extent of front ought not to exceed six miles, as Von Scherff lays it down, we must at least admit that the Reserve Brigade will be at a minimum distance of from two to four miles, and several hours must certainly have elapsed before Artillery drawn from the Reserve could come into line.

The author brings to the support of his theory some of the examples of the War of 1870, and concludes from them, that two Batteries at least are necessary for the first line. He thinks, besides, that it is indispensable to add to them a third, for the following reasons:—

When one of the Brigades comes into action in order to pierce the screen of the hostile army, it will be necessary that the Commander of the Division should have at his disposal the means of supporting it vigorously; the enemy on his side will possess Artillery, and a single

---

[1] The German mile is equal to about 4½ English miles.

Battery would not be sufficient to sustain the attack or re-inforce a defensive position. It would be very difficult to bring up in proper time the Battery belonging to the second Brigade of the first line. In case of a flank attack during the march of the Reserve Brigade being surprised, the third Battery would be of great use. The troops of the first line will have to undergo extraordinary fatigue; a third Battery would make it feasible to relieve the leading Batteries in succession. One could not think of attaching a Reserve Ammunition Section to a Cavalry Division, which ought not to drag any *impedimenta* after it; the presence of a third Battery would augment the quantity of ammunition in a satisfactory proportion. Lastly, at the moment of the attack, the time during which the Artillery will be able to act, will be very short; it is therefore necessary that its action should be vigorous. But it cannot cease altogether to reply to the enemy's Artillery; and if the Division has only two Batteries, only one could direct its fire upon the Cavalry—this is not enough. In 1870, it was soon recognized that two Batteries were not sufficient for six Regiments. During the War of the Secession, the Americans were in the same way led to give their Cavalry Division three Horse Artillery Batteries.

To complete this summary, notice must be taken of the demand for the creation of a special Remount Depôt for Horse Artillery, and for raising the purchasing price of the horses. But these claims are too just to be even disputed; the draught horses of Horse Artillery Batteries attached to Cavalry being, of all horses of the Army, those of which the greatest efforts would be required in a campaign, it is natural that their value should correspond with the services which are expected of them. Financial considerations only may still put off for some time the steps which will give complete satisfaction to this last demand. As for the separation of Horse Artillery, its principal advocates are the Officers who compose it. But many others fear, with Colonel von Schell, that Horse Artillery Batteries, if made independent, would be too apt to neglect the gun for the horse.

How many Batteries will be attached to a Cavalry Division of six Regiments? If it is impossible to give an exact answer, it may at any rate be remembered that, according to the opinion generally expressed in Germany, Horse Artillery Batteries ought not to be employed like the Field Batteries of the Corps Artillery; they would all be called upon to operate with the Cavalry.

The number of Cavalry Regiments amounts to 93, or 46½ Brigades; that of Horse Artillery Batteries to 46.

If Germany forms 10 Cavalry Divisions, as seems to be taken for granted in one of the above quotations, this formation will absorb 29 Batteries, attaching only two Batteries to the Saxon Division, and three Batteries to each of the others. There would remain 17 Horse Artillery Batteries, which would be distributed among the Army Corps, and would support the Cavalry attached to each of them.

There would even be some reason to think that two Corps would be deprived of Horse Artillery: the Saxon Corps whose two Horse Artillery Batteries would be employed with the Saxon Cavalry Division, and the Wurtemburg Corps, whose Artillery only contains Field Batteries.

NOTES:

BY VARIOUS HANDS.

THE other day, on commencing the Battery Annual Practice of 5/1, Eastern Division, at the Klippenburg Battery, Colombo, after firing the first round from a 64-pr., I went to one side to see where the shot struck. On coming back to the gun, No. 5 came and said the gun had burst and the gas was "fizzing" out. I thought both statements extraordinary, but on getting close to the gun, there was no end of a row. We could not at first make out where it came from; it seemed to be inside the breech, but there were no signs of gas coming out. At last a sergeant came up who had been eight years on the station; he recognised the sound, and said it was a "scissors grinder:" we took the stoppings out of the slot for the left tangent scale, and put the pricker down. Out dropped a big hornet, still buzzing furiously; he had gone in for a quiet sleep in a dry corner, and the rude shock of awakening had made him use shocking language. The men who were at the gun belonged to a recent draft; otherwise the cause of the disturbance would have been sooner detected, as these Batteries have been here for eight years, and most of the men are fairly well acquainted with the stinging insects that do dwell here.

Much relieved at having found out "why the gun burst," we continued the practice.—*J.P.F.*

INCIDENT IN HAYTI, UNDER THE NEGRO EMPEROR TOULOQUE, IN JANUARY, 1859.[1]

"HEARING of the danger to which all foreigners were exposed at Port-au-Prince, the Captain of an English transport, the *Melbourne*, with the consent of Captain M'Crea, who commanded a detachment of Artillery on board, steered for the capital, and arrived at a critical moment. Seeing that the French Legation was about to be invaded, Byron (British Acting Consul General) took the bold resolution of

---

[1] "Hayti, or the Black Republic," by Sir Spencer St. John, K.C.M.G. Smith & Elder, 1884, p. 98.

calling on Captain M'Crea to land his Artillerymen and protect the refugees. This they did; and strange to say, the mob, instead of resenting this armed interference, were delighted at the magnificent appearance of the men and their perfect discipline, and cheered them more than ever they cheered one of their own Regiments. This movement saved the Emperor: he and his followers were subsequently embarked on board the *Melbourne*, and followed Boyer and Hérard-Rivière to Jamaica.

"Too much credit cannot be given to this bold proceeding of Mr. Byron and Captain M'Crea; and for years afterwards the landing of these fine men was a subject of conversation among the people. All felt that more had been saved than the French Legation and the lives of the refugees, as, once pillage had commenced, it would have been difficult to prevent it spreading through the town."—*J.H.L.*

SHORT HISTORY AND DESCRIPTION OF ARMOUR

AND ITS

ATTACK BY ARTILLERY.

BY

CAPTAIN C. ORDE BROWNE, LATE R.A.

CHAPTER I.

BRIEF HISTORY OF EARLY EXPERIMENTS.

ON the history of the development of armour, Major-General Inglis, R.E.,[1] remarks that "every point, down to those of the nicest detail, has been based on experimental results," and that "in no subject that has ever been raised has mere opinion, unsupported by practical experience, proved so worthless as in this." It is not surprising, then, that the early experiments in many cases led to negative results; that is, they only proved the futility of the particular design or feature under trial. It is hardly likely to be generally useful to notice most of these experiments, which can best be studied in the printed proceedings of the Committee[2] by whom they were carried out. It is only necessary here to mention a few that stand out as landmarks, fixing the shape afterwards taken by the armoured structures themselves and the method of attacking them.[3]

In 1812, John Stevens, of New Jersey, designed a ship with a battery protected by inclined armour, and by 1841 his family, working at the same subject, had determined the resisting power of iron against the shot of the day fairly.[4]

---

1 *See* "Notes on Armoured Defences," a paper read at the R.A. Institution on April 29, 1880, by Colonel Inglis, R.E.

2 "Special Committee on Iron," 1861, 1862, 1863, 1864; also "Ordnance Select Committee Proceedings."

3 These are chiefly taken from "Notes on Armoured Defences," by Colonel Inglis. Some information on foreign and naval matters is quoted from "The Development of Armour for Naval Use," by Lieut. Very, U.S. Navy. The "Proceedings of the Special Committee on Iron" are also quoted.

4 "Development of Armour," Very, p. 235.

In 1827,[1] an experiment of an unsuccessful character was made in Woolwich as to the resisting powers of masonry faced with wrought-iron bars, on a proposal by Major-General Ford, R.E.

In 1840, some Admiralty experiments to test the action of shot against iron-plates, backed by various substances, led to the conclusion that iron was a bad material for ships of war.

In 1841, General Paixhan[2] recommended the use of iron-plates in the United States.

In 1853,[3] masonry strengthened with iron was tried in the United States.

In 1855,[4] the French employed three iron-cased floating batteries against Kinburn, and before the end of the war between England and France with Russia the English had iron-clad batteries afloat.

From 1856 to 1859,[5] further experiments against iron plates took place: the 68-pr. smooth-bore gun attacking four inches of iron thickly backed with wood. In 1858, a wrought-iron shot passed through four inches of iron and wood backing. In 1861, a target representing the first English iron-clad frigate, the *Warrior*, was attacked by a Whitworth[6] 80-pr. rifled gun, firing a steel flat-headed shot. The *Warrior* target, which consisted of 4½ inches of wrought-iron, 18 inches of teak, and ¾-inch iron skin was indented and cracked, but not perforated by this shot.

Actual introduction of armour into the construction of ships of war.

As regards the actual introduction of armour into the construction of ships of war, Lieut. Very, with great justice, observes that the United States, which is often credited with taking the lead, owing probably to the part played by iron-clad ships in the American War, and especially to the well-known encounter between the *Merrimac* and the *Monitor*, was by no means the first. He observes:[7] "The orders for the construction of the *Monitor*, *Galena*, and new *Iron Sides*—the first iron-clads built for the United States—were issued in September, 1861. Prior to this time, as has been shown, England and France had each constructed a squadron of floating Batteries; these squadrons were quadrupled in size, and rendered doubly powerful in individual ships within the next four years. In 1858, the first squadron of sea-going armoured frigates—*Gloire, Normandie, Invincible*, and *Couronne*—was commenced in France, and scarcely were their keels laid when England responded to the advance with the *Warrior*, the *Black Prince*, the *Defence*, and *Resistance*. Before the United States Congress had considered the question of iron-clads, England, France, Spain, Italy, Austria,

---

1 "Report of Special Committee on Iron," 1861–1862, p. ix., &c.

2 "Development of Armour for Naval Use," Very, p. 365.

3 "Notes on Armoured Defences," Inglis, p. 1.

4 *See* "Armoured Defences," Very's "Development of Armour," and "Proceedings of Special Committee on Iron," 1861–62.

5 *See* "Armoured Defences" and "Proceedings of Special Committee," 1861–62.

6 *See* "Proceedings of Special Committee," 1861–62. A 13-pr. shot at the present time would produce nearly the effect of this 80-pr.

7 Very, "Development of Armour," p. 367.

Denmark, and the Southern Confederacy either had iron-clads afloat or on the stocks. Before Ericsson had submitted the design of the *Monitor* to the Naval Commission, Captain Cowper Coles had demonstrated the advantages of the turret, mounted on low freeboard iron-clad hulls, in public, to the naval experts of England (*see* 'Proceedings of the British United Service Institution,' June 29, 1860). Before the United States had closed the contract with Ericsson for the *Monitor*, the Danes had made one with Coles for the double-turreted sea-going ironclad *Rolf Krake*, the progenitor of the *Huascar*, and more closely resembling her than the *Nantucket* resembled the *Monitor*."

From about 1859 the manufacture of armour-plates progressed rapidly; the plates from about this date increasing steadily in thickness. In 1860, an 80-pr. Armstrong gun was fired against iron embrasures with plates 8 inches and 10 inches thick.[1] In 1861, various backings were tried, such as timber, cork, india-rubber, layers of wire, &c. From these, it was concluded that "while the hard materials improved the resisting power of the armour, they led to its being more injured by cracking, and to the giving way of fastenings."

Jones' inclined iron plates were tried about this time; when it was concluded that a given weight of armour will protect a given vertical area equally well, whether in the form of a simple vertical plate, or of a thinner but necessarily larger inclined plate, the penetration of the shot being proportional to the sine of the angle at which it strikes the plate until the glancing angle is reached. Jones' inclined iron plates.

In 1861, the cupola of the *Trusty*, with 4½ inches of armour, was tried at Sheerness. It was in the form of a truncated cone. It resisted fire fairly well, and its machinery was not damaged.[2]

In March, 1862, the Special Committee on Iron[3] made their first report, in which they state the following conclusions, among others: namely, that steel and steely-iron are bad materials for armour, while soft, but not necessarily costly, iron is best; that corrugations and bosses, designed to break shot on impact, are undesirable; that plates should be as large as practicable; that hard backing supported the plates at the expense of the bolts, whose functions are not only to hold the plates on but also to resist vibration and prevent buckling; that tongueing and grooving[4] the edges of plates tend to spread injury from plate to plate, and are bad; and that the effect of shot on plates Special Committee on Iron.

---

1 "Notes on Armoured Defences," Inglis, p. 3.

2 "Notes on Armoured Defences," Inglis, p. 9.

3 The Committee consisted of the following:—President Sir J. C. D. Hay, R.N. (then Captain), Major Jervois, R.E., Colonel Henderson, R.A., Doctor Percy, Sir W. Fairbairn, and W. Pole, Esq. In this report the Committee divided their work into three sections: (I.) The collection and classification of results of experiments already carried out. (II.) The examination of witnesses possessing special knowledge. (III.) The carrying out of fresh experiments. The author thinks that few are aware of what valuable data and opinions are contained in the "Proceedings" of this Committee.

4 Lieut. Very, in "Development of Armour," gives a capital illustration of complicated fitting of plate edges in the *Galena*, which succumbed under the fire of Fort Darling, p. 390.

is not proportional to the momentum of the former, but to the "energy," or "stored-up work," which may be expressed by $\frac{Wv^2}{2g}$, where W stands for the weight, and v the striking velocity of the shot, and g the force of gravity.[1]

Sir W. Fairbairn made some very interesting experiments on punching and crushing iron, which were submitted to the Committee; the results being given in an appendix to each of their three reports. From them it appeared that a flat punch clipped out a disc, which was more irregular in shape, and cleft or torn across where the support was less complete. A round-ended punch met with less resistance than a flat one at first, but before the perforation was complete it experienced about double the resistance, making a round-ended impression in the plate, and eventually driving out a bent disc torn across the centre. In the case of plates, which were thick in proportion to the diameter of the punch, a star or cross-shaped tear was made with the centre opposite to the point of the punch, but a small disc-shaped fragment of plate was generally detached at the centre of the cross. Hemispherical-ended pieces of iron were crushed with half the pressure necessary to crush flat-ended ones: namely, 26·82 tons instead of 55·36 tons per square inch.[2]

It may here be noticed that the soft iron having been adopted, a hard-pointed projectile was sooner or later almost certain to come in, in spite of the advantages at first presented by flat heads. Such a projectile would meet with but little resistance as its point entered, and by the time that it was so far in the plate that the resistance had approached the maximum, the head of the shot would be well supported, and its condition would be almost that of a cylindrical shot driving a pointed wedge in front of it. Whereas had a very hard plate been adopted the shot would meet with abrupt resistance directly its point touched the plate, and would experience a mechanical strain somewhat analogous to the outward thrust that falls on an arch. To this is probably to be attributed the ease with which a hemispherical-ended piece of iron is crushed.

Palliser shot.

The late Sir William Palliser seized on this idea and applied it to great advantage by the introduction of ogival-headed chilled-iron shot, to which he rightly gave sharper points than were afterwards approved for the Service. The advantage of a very long sharp point is apparent when it is borne in mind that the plate yields by bulging and tearing

---

1 Fairbairn suggested the following equation for punching:— $t = \sqrt{\frac{Wv^2}{CR}}$, in which t = the thickness of plate punched, W and v the weight and velocity of shot, R its semi-diameter, and C a constant to be determined by practice. This is the same equation as $\frac{Wv^2}{2g} = \pi D \times t^2 \times k$, where the energy of the shot is just equal to the circumference of hole made, multiplied into the square of the thickness of plate and a constant determined by practice. Nothing better than this equation exists at the present time for perforation.

2 "Transactions and Report of Special Committee on Iron," 1862, p. 5.

open at the back; for, in addition to the shot bearing the shock of impact better as noticed above, the actual point is applied more immediately to the spot where the tear is to commence, and thus the work of tearing is greatly facilitated. Palliser's projectiles were first tried at Shoeburyness on November 12, 1863.[1] Up to this time it may be noted that the heaviest rifled gun employed was a 10½-inch rifled gun, throwing a shot weighing 300 lbs.,[2] with a muzzle velocity of 1320 feet. There was also a 7-inch Whitworth 130-pr., and a 13-inch smooth-bore Horsfall gun.

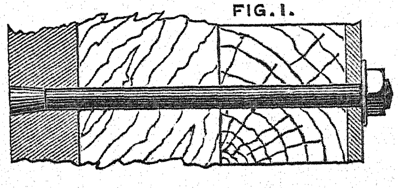
In America, before this time, iron-clad ships had been made from new designs, and also contrived by converting other vessels into armoured structures covered with railway iron, and the like. The *Merrimac*, the *Atalanta*, the *Tennessee*, the *Monitor*, the *New Ironsides*, the *Weehawken*, the *Montauk*, the *Nantucket*, the *Nahant*, the *Keokuk*,[3] and others, had played their parts in the war. Laminated armour, of which the chief recommendation had been ease of manufacture, was shown to be very inferior to solid wrought-iron plate.[4] Where perforation is effected by means of a pointed projectile, it may easily be seen that this is only what might be expected. The shot finds a passage through by tearing a ragged hole and bending back the corners, and these will bend back easily in the case of laminated armour, because the layers slip on each other and accommodate themselves to the bending, just as it is easier to bend up the corner of a book away from the back than one next the back where the edges of the leaves are fastened together.

Laminated armour.

About this time, also, much had been learned with regard to armour-bolts. The early English ships, such as the *Warrior*, *Minotaur*, &c., had through-bolts with conical heads holding in the armour, and screwed ends nutted against the skin, the nut and conical head holding armour and skin together (Fig. 1). The French had adopted wood

Armour-bolts.

FIG. 1.



screws,[5] by which a bolt with a conical head held the armour to the backing, into which the screw held by a projecting thread (Fig. 2). The advantages of the French bolt[6] were that there was no langridge in action from heads flying off, and no leakage through a bolt-hole, and there was a saving of weight of nearly one-fourth on the bolt, which

---

1 "Report of Special Committee on Iron," 1863, p. 159.

2 "Armoured Defences," Inglis, p. 3.

3 *Vide* "Development of Armour," Very, p. 396, &c.

4 About six inches of laminated was thought to be equal to four inches solid.

5 Wood screws were tested severely with great success in America during the war, *see* "Development of Armour," Very, p. 402.

6 "Development of Armour," Very, p. 380.

amounted to tons on the entire vessel. The importance of the second advantage is evident from the fact that numbers of casualties were

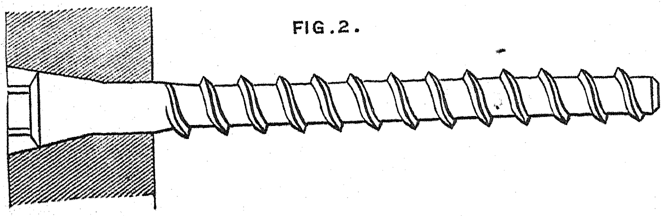


FIG. 2.

caused in the American War by the bolt-ends and nuts.[1] Further, the strain was better distributed throughout the length of these bolts than in those of the English first pattern. The value of elastic washers to bolts was soon made apparent in England; but the first important step was made when, in 1862, Sir W. Palliser proposed a projected thread of a screw to remedy the evil of weakness caused by cutting a thread—a weakness not at all measured by the mere diminution of cross section by the cut, for such a cut almost instituted a commencement of fracture, and certainly gave so limited and distinct a weak place that all the yielding of the bolt would take place there instead of being distributed along its length. This tendency to yield in one place is similarly encouraged by anything which may nip the bolt at any point. On this account, Major English, R.E., suggested leaving a clear space round the shank of the bolt between the bearings at the ends, and further proposed a spherical nut and bolt-head, and a hemispherical cup or seat in the plate, so that each end of the bolt should be capable of a ball-and-socket movement, which would enable it to accommodate itself to any slight displacement of the plates, which are united in pairs, that is, each plate is bolted only to the one next to it in plate-upon-plate targets (*vide* Fig. 3).

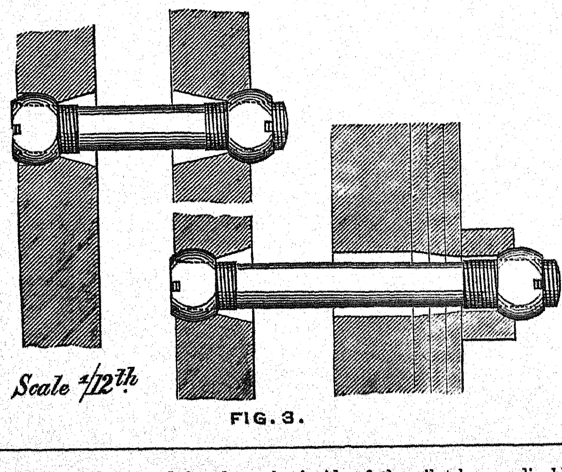


FIG. 3.

[1] On the *Nahant*, the bolt nuts, flying from the inside of the pilot-house, disabled the pilot and mortally wounded the helmsman, disabling the steering-gear at the same time. In addition to these, five men in the turret were disabled by flying bolt nuts.—"Development of Armour," p. 396.

The *Chalmers*[1] and *Bellerophon*[1] targets had before this date been tried. These contained the feature of angle-iron stringers in the backing, intended to give support to the plates and rigidity to the structure, without the evil of transmitting the shock of impact to the bolts and fastenings more than necessary.

The introduction of heavier ordnance, such as the 13·3-inch gun, throwing a 600-lb. shot, capable of piercing the *Warrior* at a range exceeding two miles, caused thicker armour to come in. The *Hercules*, consequently, had 9-inch plates at her water-line, and a target representing her, with massive backing of teak and iron stringers, with ribs and skin, resisted the last-mentioned gun at 700 yards, and would have done so at much shorter ranges.[3]

Masonry casemates with ports in iron shields.

In 1865, as General Inglis relates,[4] "two complete masonry casemates with ports in iron shields were built at Shoeburyness. The masonry was 14 feet thick, consisting, generally, of a face of 6 to 8 feet of stone with brick-work behind it, the side-walls and vaulting of the casemates being of brick. The shield of one was a compound structure 12 feet long, 8 feet high, and altogether 21 inches thick (including 7 inches of wood); that of the other was made out of a solid rolled iron plate, 7 feet high, 6 feet wide, and 13½ inches thick. After the mounting, working, and firing of a 23-ton gun, and a 12-ton gun in the casemates as well as on the roofs, had proved the work to be suitable in arrangement for such guns, the front of the work was attacked by a battery of 7-inch, 8-inch, 9·22-inch, and 10-inch guns at ranges of 600 and 1000 yards, firing steel and cast-iron shot, some with hemispherical and some with elliptical heads.

"The general result of this trial was that after 33 hits the work began to become untenable, after 54 hits its fire would have been virtually silenced, and after 86 hits, of which 22 were on iron, the masonry front was destroyed, but the shields still offered a fair amount of protection. The aggregate of all the blows delivered came to 200,000 foot-tons, of which 52,000 were on iron.

"The issue of this experiment was of the utmost importance to the Service, because on it were based the decisions (1) that our most advanced and important sea-forts should be protected by walls consisting wholly of iron, and (2) that for other coast batteries masonry might be used, but that every gun casemate of these should have a shield affording protection against fire, equal, *at least*, to that of its own gun. A series of trials of plates of steel, and steel and iron combined, at this time showed that at this stage of the development of armour a simple rolled plate of soft iron formed the best shield."

---

1 *Chalmers* target, tried May 4, 1863, consisted of 3¾-inch iron plate on 10¾-inch backing of horizontal wood and iron stringers, then a 1½-inch plate, and 3¾-inch wood, and ⅝-inch skin (iron).—"Proceedings of Committee," 1863, p. 183.

2 The *Bellerophon* target, tried December 8, 1863, consisted of 6 inches iron, 10 inches wood backing with angle-iron stringers, and double layer of ¾-inch skin.—"Proceeding of Committee," 1863, p. 195.

3 Inglis on "Armoured Defences," p. 4.

4 *Ibid.*

In 1866, a *Royal Sovereign* turret was tried at Spithead with *Bellerophon* 12½-ton guns; the turret suffered, but not in its turning machinery.

In 1864,[1] steel plates supplied by the Thames Company, Brown & Co., the Parkgate Company, and Petin and Gaudet were tried in Russia without success. A very important feature now found its way into English armour, that is, the plate-upon-plate, or sandwich system. Colonel Inglis relates this in the following words:[2] "In consequence of the growing powers of battering ordnance, it now became evident that our land-works would require walls of considerable thicknesses of armour; but there were two main reasons why very thick armour-plates should not be used in them. In the first place, the manufacture of a very thick plate is not so complete as that of one of moderate thickness, or at least to make it as complete would involve an enormous increase of cost in plant and manufacture; and next, the thicker the plates the deeper the joints must be, and therefore the more points of undue weakness will the armour present. It therefore became important to see whether the required protection could not be gained without the use of very thick plates. Against doing this was the prevailing opinion, based chiefly on theoretical considerations, that a single plate of given thickness would offer something like twice the combined resistance of two plates each of half that thickness, or about three times the resistance of three plates making up the same total thickness, and so on. This view was entirely disputed by those who had to deal with these questions officially, but it became our business to prove its fallacy. This was done under the following circumstances: In 1867, a total thickness of 7 inches of iron disposed in one solid plate in two plates of 3½ inches, and in three equal thicknesses, instead of giving resistances of about 100, 50, and 33, gave effects more nearly as 100, 95, and 88 respectively. Next a 10-inch plate failed to stop a shot which was stopped by two 5-inch plates, and another 10-inch plate bore out this result.

Plate-upon-plate, or sandwich system.

"Again, in a comparison between a solid 15-inch plate and a wall made up of three 5-inch plates, the result was that, although the solid plate gave a somewhat better resistance to a single blow, the three-plate structure stood repeated blows better than the other. Also in 1871, two targets representing portions of walls of ships' turrets were tried at Shoeburyness. The one was protected by single 14-inch plates, the other by two thicknesses of armour 8 inches and 6 inches respectively, with 9 inches of timber between them. In other respects the targets were similar. After receiving the same amount of battering the armour of both was taken off, and the effect upon the inner skin of the two-plate target was unmistakeably less than that on the single-plate structure.

"It may also be mentioned that, more recently still, a structure

---

[1] "Development of Armour," Very, p. 466; "Notes on Armoured Defences," Inglis, p. 9.

[2] "Notes on Armoured Defences," Inglis, p. 5. It appears as if "plate-upon-plate" ought to refer to iron plates touching each other, and "sandwich" to similar plates with wood or other material between; but the words have not been so used.—*See* "Targets for Trial of Heavy Ordnance," p. 3, Inglis. Perhaps all targets containing more than one layer of iron may be included under the term plate-upon-plate, and those with the intervals between the plates filled with other material further distinguished, when necessary, by the term sandwich.

composed of three thicknesses of 6½ inches of iron proved rather superior to a solid 16½-inch plate in stopping the 818 lb. shot of the Service 38-ton gun, striking with a velocity of about 1415 f.s.

"In thus dealing with the subject, it must not be supposed that the formation of iron walls made up of a number of very thin plates was ever advocated by us. The trial of the boiler-plate targets, already mentioned, for ever disposed of that kind of construction.

"Also, it should be mentioned that the above trials of the plate-upon-plate system showed plainly that the most satisfactory results were not obtained when the surfaces of the armour were in contact, but that, on the contrary, some thickness of a softer and more elastic material between the plates was necessary to prevent their breaking under heavy blows.

"To settle the best proportions, quantity, and best nature of material to be interposed between armour-plates, a series of careful experiments were set on foot, and the result was that a uniform spacing of about 5 inches (to be slightly modified under certain circumstances) between the different plates in all structures was decided upon; and also, although an iron-concrete, made by working up together cast-iron borings, asphalte, bitumen, and pitch, gave the best result, mainly on account of its great weight, yet brickwork in asphalte, Portland cement, concrete, and hard wood proved so satisfactory that these materials have been adopted, as circumstances required, in all our armoured walls."

A word or two of explanation may be here useful. It has already been explained that the shot perforates the plate by forcing its way through, so that the plate is stretched over the shot's point, and forced back until it tears in the shape of a cross or star; the shot's point comes through in the centre, bending the corners of metal back, eventually tearing them off, the shot passing clean through. In the case of a wood layer between the plates, it has been established by a series of experiments that the wood should be sufficiently thick to prevent the plates jarring together and cracking, but not sufficiently thick to give room for the shot's point to clear itself of the bent edges of the first plate before it impinges on the second. Practically, 5 inches has been found a good thickness for the wood, and adopted generally in this country for plate-upon-plate sandwich armour. It is made up of two layers, one of 2½-inch planks laid horizontally, and the other of 2½-inch planks laid vertically. In the course of plate-upon-plate trials it was found that a very remarkable result was produced on chilled-iron shot, on passing through iron plates with air-spaces between them. Projectiles which perforated the front plate were found disintegrated, a small part adhering to the second plate, in a mass whose consistency was rather that of metal powder pressed together than of solid metal. This effect has been repeatedly produced; one or two cases are noticed in experiments given hereafter (*see* air-space targets).

Air-spaces.

Remarkable as this result was, it never led to any definite attempt to utilize air-spaces, because there was reason to believe that by means of shells the front plate might be blown entirely off, and also because steel projectiles were coming into use abroad, and on these air-spaces have not been found to produce the same effect.

CHAPTER II.

Introduction of Formulæ for Application to Experiments.

The destruction of armour by shot is an illustration of the "rule of work." The "stored-up work," or "striking energy" in the projectile being converted into destructive effect on the target in the measure in which the former is fairly brought to rest. There are, as might be expected, many causes contributing to complicate what otherwise would be a very simple question. The high velocity and great violence exerted produce effects which it is very difficult to measure. The shot itself often becomes shivered and heated, and work is lost by the actual motion imparted to fragments. These are necessarily subject to great variation, and hence it follows that there is a limit to the degree of accuracy with which results may be calculated, the most favourable conditions being probably such as to allow a shot to completely penetrate, or, as it is termed, *perforate* armour with but little spare force, the shot being unbroken and the pieces of plate detached without being violently projected to a distance.

It is well, however, to pause here before becoming occupied with any special forms of destruction of armour, each of which must be dealt with according to its nature.

From the beginning there existed two distinct systems on which armour might be destroyed—termed "*punching*" and "*racking*." On the first system the projectiles are driven completely through the armour, with the object of taking effect on the guns, men, and whatever may be behind it. On the second system, the armour itself is broken up and destroyed, leaving the structure it covered exposed to the effects of subsequent fire. The results obtained by complete punching, or perforation, are more direct and immediate. On the other hand, those obtained by racking are, as regards the armour itself and the future defence of the ship, more decisive, unless, in punching, shells can be made to pass intact through the armour and explode in the interior. The former system was originally followed in England, the latter in America, as being suited to the American cast-iron heavy guns discharging projectiles of great mass with low velocity. It was at one time supposed that racking had become nearly obsolete.[1] The early experiments with cast-iron and steel armour were very discouraging; and thick wrought-iron with wood backing was long thought to be the only form of armour that was likely to be employed, a form which is peculiarly capable of resisting racking, while it admits

[1] The distortion of turrets, as attempted in the *Glatton* experiment at Portland, in 1872, comes under the head of "racking" in the original sense.—See *Glatton* experiment.

of being punched by suitable projectiles. Hence the English experiments for some years consisted almost wholly of trials as to the punching powers of certain individual guns and projectiles, and the resisting powers of structures consisting of wrought-iron supported by backing of different kinds; the chief variation in conditions being the increasing scale on which the experiments were conducted, owing to the ever-increasing power of the guns and thickness of the plates. Exceptions of course occurred, and the backing and the fastenings of the armour, and form and nature of the projectile were constantly studied; still, it has been mainly a question of punching wrought-iron in one or another form until late in 1876, when both chilled-iron and steel became the subject of more special trial on the Continent. These, it shortly appeared, did not admit of being punched like wrought-iron; while, on the other hand, it was possible to shiver them in a way that was impracticable with good wrought-iron. Steel and chilled-iron have now both of them been adopted to such an extent that racking deserves attention as fully as punching.

This racking, however, is not generally of the same character as that originally advocated in America, for modern vessels or forts are covered with massive steel or chilled-iron armour which is liable to be broken and thus detached; whereas the early American iron-clad ships were protected not by the thick wrought-iron spoken of above, but by thin iron plates superimposed in layers, forming what is termed laminated armour. This, it was found, could be destroyed by bending, and so tearing open the ship's side.

To calculate the stored-up work, represented by injury done in racking in either form, is clearly much more difficult than in the case of "*perforation*" or complete penetration, though, no doubt, the rule of work is equally fulfilled in each case.[1] The question of partial pene-

---

[1] The author thinks that Very must misunderstand him. In his criticism on the author's U.S.I. paper—See "Development of Armour," pp. 460–461,—Very concludes by saying: "If Captain Browne's argument be followed to a logical conclusion, and it be assumed that the hardness of the steel be increased, whilst its other properties remain the same, then the same blow would shatter the plate much more, unless, of course, it be argued that the act of shattering absorbs energy, which cannot possibly be the case." The author had stated that steel had "a remarkable power of distributing into its mass the shock of impact," so as to stop the shot, but at the expense of extending the area of destruction. Perhaps the meaning is best explained by an illustration. At Spezia, in 1876, the 100-ton gun projectiles passed through the wrought-iron plates, fragments having still some velocity left in them, in the case of one fragment, 600 feet per second. Similar shot were stopped by the steel altogether, but the steel plates were completely broken up. The perforation in the wrought-iron had cost a certain quantity of energy, but the shot fragments had still some left in them and travelled on. The fracture of steel had absorbed all the striking energy, and had stopped the shot. If the precise action of fracture were understood, the energy expended in producing each part of each crack might be worked out, and the whole, with the breaking of shot, the heat developed, &c., would, no doubt, equal the striking energy of the projectile. The author, by the expression that the armour absorbed the shock "in the act of going to pieces," meant exactly what Very expresses by the words "It is the projectile-energy which has been transferred to the plate that causes it to go to pieces." The wrought-iron at point of impact gave back and pulled asunder. The steel stood up to the work, transmitting the shock from particle to particle, until it was distributed into a considerable mass of the plate, the material splitting in all directions. The author had observed that steel undoubtedly differed from wrought-iron in this power to distribute the shock. He had, however, doubted if a claim could be made for steel that

tration, effected on the punching system, is also a difficult one; it is, however, of much less importance than complete perforation. A shot entering wrought-iron does little injury, except at the immediate spot it strikes, for the nature of soft wrought-iron causes it to yield locally rather than to transmit the shock through its mass; consequently, with the exception of a little tearing at the back, the injury effected in wrought-iron is generally confined to the punching out of a hole; and in the case of partial penetration, this hole may often remain plugged up by the projectile. Thus, it follows that in most cases wrought-iron plates bear continued firing very well. They may allow projectiles to pass through them, but they hold well together and suffer little loss in future resisting power from perforation, and still less from partial penetration. Hence, seeing that a shot which stops mid-way in its course through wrought-iron plates can itself produce comparatively little injury to those behind such armour[1], and that it weakens it very little, it is the least important case of effect produced that has to be considered on service.

Perforation, meaning the actual passage[2] of the shot through the plate, may with advantage be first considered generally, so as to arrive at a formula sufficiently correct to enable the results of experiments to be noted and compared, before discussing them in detail. To this end it will also be necessary to notice generally the quality and behaviour of different kinds of projectiles.

Piercing of wrought-iron plates.

Wrought-iron plates owe much of their value to the fact that they do not transmit the shock to the bolts and adjacent parts of the structure, but absorb the blow locally. Hence they may be penetrated easily, but crack comparatively little, especially if supported by soft backing. Penetration is effected in various ways, depending on the form and nature of the projectile employed.

The appearance of a shot after impact accords with the supposition that it is subjected to pressure exerted in lines which lie in a normal direction to the surface of the head of the projectile as it forces its way through the armour. A spherical cast-iron shot invariably breaks

---

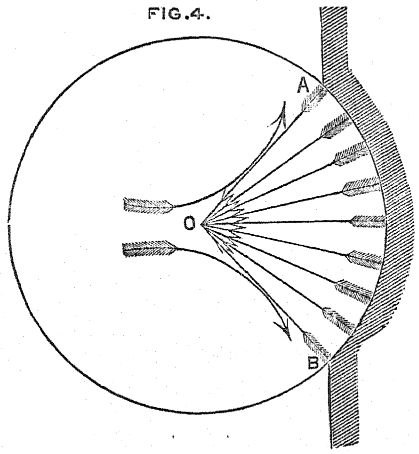
a given quantity of stored-up work effected actually a smaller injury on it. That is, suppose the shock could be equally distributed through the wrought-iron, he doubted if it could be proved that it would break it up more than steel. The undoubted property possessed by the steel was power of *distribution* of shock from particle to particle, which was connected with its hardness. Subsequently, in a Paper for the R. A. Institution, April 13, 1883, the author expressed his belief that steel of some kind ought, in the long run, to beat wrought-iron (*see* quotation in Note, Chap. XI.), having greater ultimate tenacity and greater elongation; that is, although, in 1882, he questioned if actual superiority in resisting power had been proved, in 1883 he thought it ought to be found so in the long run.

[1] Chiefly effected in the flying off of bolt-heads.

[2] Exact *perforation* is when the shot just passes through with no spare energy to carry it further. This can hardly happen in practice, but sometimes a near approach to it is seen. If part of a projectile remains lodged, and part gets through with energy sufficient to have cleared the lodged portion, the energy has been the equivalent of exact perforation.

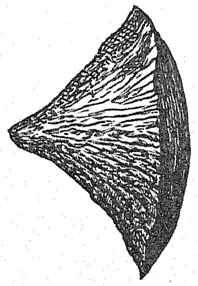
up. The anterior part, being under pressure, as shown in Fig. 4, commonly forms a wedge with the point presented towards the rear,

FIG. 4.



upon which the posterior part coming under violent tensile strain splits itself, the front part being afterwards picked up as a fragment, such as that exhibited in Fig. 5. Of course a great part of the work stored up

FIG. 5.



in the shot is thus wasted. A spherical wrought-iron or soft steel shot is subject to the same forces, speaking generally, but yields in a different way by spreading out, as shown in Fig. 6. A flat-headed projectile meets with resistance directly along lines parallel to its axis, hence there is no tendency to form a wedge-like anterior fragment. Sir J. Whitworth's projectiles, being made of steel, hold well together, flattening or setting-up slightly. Ogival-headed projectiles have little tendency to form a wedge out of the anterior portion under pressure of impact. At first the resistance is comparatively small, and it may be seen by Fig. 7, that, by the time the head has entered sufficiently far to meet with great resistance, the normal lines are in such directions that the shot is nearly in the position of a cylinder driving before it an ogival wedge, whose form, while available to open the armour, has little splitting reaction on the shot itself. The fractured head, Fig. 8, is an example of what is commonly produced

in soft armour. When made of chilled cast-iron, the projectile has comparatively little tenacity, and the posterior portion generally shivers

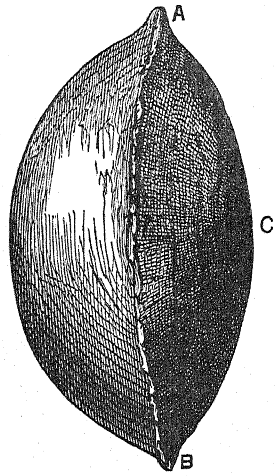


FIG. 6.

to pieces; nevertheless, the density and hardness of the metal are such that Palliser projectiles long held their own against all others.

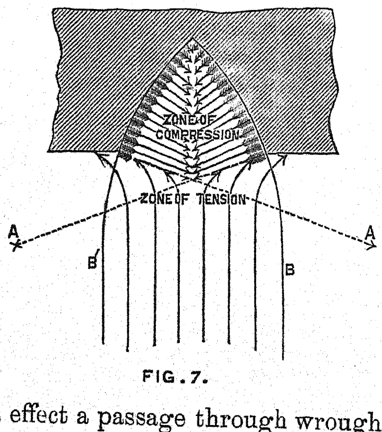


FIG. 7.

These projectiles effect a passage through wrought-iron by punching

FIG. 8.

or tearing a hole. Fairbairn, at a very early stage of the investigation

of the question, suggested the following equation as, in a measure, representing the state of matters. This has since been employed, with modifications, by most officers who have dealt with armour-plate experiments in England. Captain Andrew Noble, Colonel W. H. Noble, R.A., and other officers connected with early Experimental Committees employed it. General Inglis, R.E., and Colonel Maitland, R.A., have latterly adopted other formulæ, and Major English, R.E., has from an early date used one of his own. Fairbairn's formula is, however, the one that ought first to be considered: it is as follows:— Fairbairn's formula.

$$\frac{Wv^2}{2g} \pi D t^2 K;$$

where W = the weight of the shot, in lbs.

v = the striking velocity in feet per second.

g = the force of gravity = 32·19 feet per second.

D = the diameter or calibre of the shot, in inches.

t = the thickness of plate completely penetrated, in inches.

K = a certain constant whose value depends on the quality of the plate, &c.

As it is convenient to take the weight of the shot in pounds, and to give the stored-up work in foot-tons, the factor 2240 must be embodied in the denominator of the fraction on the left hand side of the equation, in order to bring the answer, which would otherwise be in foot-lbs., to foot-tons.

It may be seen that the left hand side of this equation, sometimes expressed by the letter "E," truly represents the stored-up work or energy of the projectile at the moment of impact.

The right hand side is open to objection; in fact it only claims to give an approximate and partly empirical solution of the question.

It may be seen that the assumption is made that the plate yields in a circle, πD, coinciding with the edge of the cross section of the projectile. Some have contended that the resistance is proportional to the area of the cross section, not to its circumference; and R^2 therefore enters into the expression employed by them. In certain cases of slight penetration into thick plates this may appear to be true; but it can be shown in cases of complete penetration, or anything nearly approaching it, that the circumferential assumption is more nearly correct.

Flat-headed, and even hemispherical-headed, projectiles punch holes in plates by driving out the piece against which they impinge; thus in separating it from the rest of the plate they clearly tear the iron through in a circle, whose circumference is expressed by πD, as seen in equation above. The ogival point finds its way through the plate in a line in prolongation of the shot's axis: the head tearing the plate open, and bending it aside in all directions. If wrought-iron plates that have

been partially penetrated by ogival shot be examined, it will be found that the plate first yields by bending back opposite to the shot's point, tearing open in the form of a star or cross. This will be particularly well shown by and bye in Fig. 6, *Nettle* Trials, Chap. V., "Back view of wrought-iron standard plate." As the shot proceeds, it bends back the corners of the plate thus formed until they break off, leaving a circular hole, probably less than the full diameter of the cross section of the projectile, but easily enlarged so as to allow the latter to pass through. This action requires special notice, as having an important bearing on the plate-upon-plate system. On this principle a plate is torn through along lines whose total length may be expressed as $2D + \pi D$, supposing the plate opens in four cracks at the back. Theoretically, then, the flat-headed shot ought to get through a plate with less resistance than the ogival, if it was exactly a case of clean punching; and this has been pleaded in favour of the former, when an unbacked plate is fired at. Obviously, however, the rough disc of iron which is driven out in front of the flat-headed shot meets with enormous resistance as it gets foul in the backing; while the clean point of the ogival-headed shot, which has disposed of the plate in the manner described, cleaves its way easily through backing and skin; and the case becomes stronger where the armour consists of several layers of plate and backing.

Further, a sharp point has so great an advantage in commencing a tear, that for direct penetration of wrought-iron flat-headed projectiles have long since been abandoned, even by Sir Joseph Whitworth, who has warmly advocated their use for certain other purposes.

The truth of the equation given above depends on two assumptions, which are incorrect in a greater or less degree :—

1st. That the work done on the plate is proportional to the circumference of the hole made.

2nd. That the resistance of the plate is proportional to the square of its thickness.

The first of these two is a rough approach to what actually takes place. The second is confessedly empirical, and is modified by almost every one, according to their experience. For a long time this formula was employed in the Dèpartment of the Director of Artillery, in the following shape :—

$$\frac{Wv^2}{2g} = \pi D t^{1 \cdot 6} \times 2 \cdot 53.$$

Here $K = 2 \cdot 53$, and t is raised to the $1 \cdot 6$ power empirically.

The factor 2240 being, as above noticed, employed always in the denominator of the fraction on the right hand side, when W is put for the weight of the projectile in pounds. Of course all the constant

parts of this expression might be included in one term; it is convenient however sometimes not to do so.

It may be required to obtain simply the total energy "E" of the shot on striking, in order to ascertain the racking effect produced on steel or chilled-iron, which cannot be punched. For example, if it were wished to compare the relative penetrating and racking powers of the English 38-ton gun and Krupp's more modern 24 centimetre (9·45-in.) gun, it would be found that the thickness of wrought-iron plate which each would penetrate would be about equal, but the relation of energy of the former to that of the latter would be about $11\frac{1}{4}$ to $8\frac{1}{2}$, which would represent their probable relative powers of smashing up steel or chilled iron.

Another standard of comparison has also been employed, namely, the energy per inch circumference, written as "*e*"[1]. The value of this depends on the supposition that the plate is punched or sheared at the circumference of the projectile, and therefore resists the passage of the shot in proportion to the circumference of the hole that the shot makes. On this supposition we may find "*e*," the "penetrating figure," as it is called, of any shield; that is, the work necessary to shear each inch of that plate; and it will follow that any projectile with that quantum of energy per inch circumference will penetrate that shield. This is sometimes applied to a structure consisting of plate and backing. Thus 53 was abundantly proved to be the necessary figure for the *Warrior*; that is to say, it was found that any projectile from any gun having 53 tons energy per inch circumference was capable of perforating the *Warrior* target.

The formula we have presented above, then, might be used without much increase of trouble, giving these three successive results, viz.:— *first*, "*E*" the *total energy*, representing truly the actual blow, and being available for *racking*; *second*, "*e*" the energy per inch circumference, or *penetrating figure*, which allows ready application to any structure, single or compound, whose figure has been ascertained practically: *third*, "*t*" the actual thickness of wrought-iron in a single plate which can be *perforated* under the given conditions.

These results, obtained by the equation given above, as employed in the Director of Artillery's Department, were very nearly correct for the thinner kinds of armour and the projectiles used until the last few years; and, by a curious coincidence, they maintained their credit better than they deserved, with any who were imperfectly informed; for, as the armour grew thicker, the so-called "plate-upon-plate" or sandwich system, consisting of alternate layers of iron and wood backing, came in, as described in Chapter I.; and it happened that while the increase of total thickness in iron was itself adding to the power of resistance at a greater rate than allowed for in the formula as stated above, the division of the iron into three or four layers gave a falling off of actual power to resist perforation to an extent that very nearly compensated for the extra rate of increase just noticed.

---

[1] So expressed in "R. N. Gunnery Manual," 1880. In Major W. H. Noble's Report, in 1866, this is designated by "*p*."

For these plate-upon-plate targets, General Inglis established the following approximate rule.[1] The resistance to perforation of any given thickness of wrought-iron armour, made up of single, double, or three layers of iron, with about 5 inches of wood between them, is proportionate to the numbers 100, 96, and 89. Thus a result obtained for a single or solid plate may be corrected to apply to a double plate by multiplying by 100, and dividing by 12 and 8, and sufficiently correctly for three thicknesses by multiplying by 10 and dividing by 9.

It was found that the modification of Fairbairn's formula with t, raised to the power 1·6, does not give correct results when the power of the gun is sufficient to deal with thick plates, say equal to $1\frac{1}{4}$ diameters of the shot and upwards. Consequently other formulæ have been devised. It will be found, however, that Fairbairn's formula in its original form, with t raised to the second power, gives results requiring but slight correction for the perforation of thick plates, and for all kinds of armour it needs probably as little empirical correction as any formula known.

It may be well to illustrate what has been said, by working out one example fully;[2] a simple case is furnished by the firing of the 38-ton gun, 12·5-inch calibre, at a solid unbacked wrought-iron plate 16·5 inches thick, on August 1st, 1877.

Here weight of projectile, $W = 817$ lbs.

Striking velocity ...... $v = 1410$ feet.

Diameter of shot, ... $D = 12{\cdot}43$ inches.

Fairbairn's old formula is thickness perforated, $t = \sqrt{\dfrac{Wv^2}{2g} \times \dfrac{1}{\pi D} \times \dfrac{1}{K}}$.

Writing the factors inside the root in a convenient shape to find successively the total striking energy E, that is $\dfrac{Wv^2}{2g}$; then the energy per inch circumference e, that is, $\dfrac{Wv^2}{2g} \times \dfrac{1}{\pi D}$; and finally the total thickness that can be perforated t. These, as has been noticed, are all useful functions, and it is easy to follow a process bringing them out in succession.

---

[1] *Vide* previous chapter.

[2] Four-figure Logarithms are employed; they are accurate enough for the purpose. Much time is saved by using a card with the logs all on one side of it, so as to prevent the necessity of turning over leaves. Log tables of this nature were printed by the R. A. Institution, on Professor Bashforth's suggestion. Separate tables are supplied for finding logs to numbers and numbers to logs. This is convenient, but the single table given in the succeeding chapter is of course sufficient.

Here then,—

$$\begin{aligned} \text{Log } 2 &= 0{\cdot}3010 \\ \text{Log } g^* &= 1{\cdot}5077 \\ \text{Log } 2240\dagger &= 3{\cdot}3503 \\ \hline \text{Log } 2g, \text{ \&c.,} &= 5{\cdot}1590 \end{aligned}$$

$$\begin{aligned} \text{Log } \pi \ \ldots &= 0{\cdot}4971 \\ \text{Log } 12{\cdot}43 \ldots &= 1{\cdot}0945 \\ \hline \text{Log } \pi D \ \ldots &= 1{\cdot}5916 \end{aligned}$$

* g is taken as 32·19.

† To bring the stored-up work or energy to foot-tons. The weight of the shot is always given in lbs., and unless this factor were used to bring lbs. to tons the answer would come out in ft.-lbs

$$\begin{aligned} \text{Log } W \text{ (817 lbs.)} &= 2{\cdot}9122 \\ 2 \text{ Log } v \text{ (1410 feet)} &= \begin{cases} 3{\cdot}1492 \\ 3{\cdot}1492 \end{cases} \\ \hline \text{Log } Wv^2 \ \ldots \ \ldots &= 9{\cdot}2106 \\ \text{Log } 2g, \text{ \&c.} \ \ldots \ \ldots &= 5{\cdot}1590 \\ \hline \text{Total energy } \underline{E = 11263} \text{ foot-tons} \ldots \ \ldots &= 4{\cdot}0516 \\ \text{Log } \pi D \ \ldots \ \ldots &= 1{\cdot}5916 \\ \hline \text{Energy per inch } \underline{e = 288{\cdot}4} \ \ldots \ \ldots \ \ldots &= 2{\cdot}4600 \end{aligned}$$

If the square root of this were taken without any correction the result would be $t = 16{\cdot}98$ inches; but to prevent the danger of readers casually using this as a type when thus imperfectly given, a slight correction, K, is made on a plan explained in next chapter.

Repeating then,—

$$\begin{aligned} e = 288{\cdot}4 &= 2{\cdot}4600 \\ \log k &= \bar{1}{\cdot}9845 \\ \hline \text{inches} \quad & 2\,)\ 2{\cdot}4755 \\ \hline t = 17{\cdot}29 \ \ldots \quad & 1{\cdot}2378 \end{aligned}$$

Fairbairn's formula, as modified and used for some years in the Director of Artillery's Department is, as noticed above,—

$$t = \sqrt[1{\cdot}6]{\frac{Wv^2}{2g} \times \frac{1}{\pi D} \times \frac{1}{2{\cdot}53}}.$$

That is to say, it differs only from the above in the last process, when a different root and constant are employed, as follows :—

$$\begin{aligned} e = 288{\cdot}4 &= 2{\cdot}4600 \\ \log 2{\cdot}53 &= 0{\cdot}4031 \\ \hline 1{\cdot}6 & \begin{cases} 4)\ 2{\cdot}0569 \\ {\cdot}4)\ \ {\cdot}51423 \end{cases} \\ \hline t = 19{\cdot}31 \text{ (inches)} \quad & \ldots\ 1{\cdot}2856 \end{aligned}$$

The results is, in this case, much further from the truth than the results given by Fairbairn's old equation, without the application of any correction K. This would be supported by any of the later formulæ used, and it is borne out by the result on this occasion, when the projectile got through the plate, breaking to pieces and having a little spare work in it, so that Inglis[1] estimated it as able to perforate a plate from 17 to 17·5 inches thick.[2]

It may be seen that Log $2g$, &c., $= 5\cdot1590$, and Log $\pi = 0\cdot4971$ are constants available for all examples. The calculation of results of experiments is further discussed in the next chapter.

---

[1] That is to say, Inglis estimated that from 17 to $17\frac{1}{2}$ inches solid plate would correspond to a certain sandwich target (No. 40) which was as nearly as possible a match for this shot; *see* Inglis' paper on "Targets for Heavy Ordnance," R.E. Institution, 1877.

[2] A diagram, brought out by Colonel Maitland, gives 17·14 inches, and one by Colonel Inglis 17·2 inches. A rule of thumb, recommended for rough estimation, by the author, gives 17·6 inches (for these see next chapter).

(*To be continued.*)

BATTLE FIELDS

IN THE

LE MANS CAMPAIGN.

BY

CAPTAIN R. F. JOHNSON, R.A.

No. 11.

ST. HUBERT-CHAMPAGNÉ.

10th January, 1871.

ALTHOUGH most of the front of the French position on the Auvours Heights is visible from the Artillery polygon north of the high road to St. Calais, the whole of the movements of the troops engaged on the 10th and 11th January cannot be followed from any one site; and, in consequence, a summary of the battle will be given before the ground is described.

On the morning of the 10th January, which was dark and snowy, General de Chanzy held the Auvours Heights, an isolated piece of high ground, $2\frac{3}{4}$ miles long, on the left bank of the River Huisne, with General Gougeard's Breton Corps, and Paris's Division of the 17th Corps. The only communications these troops had with the remainder of the French Army were a bridge on the left at Champagné, two bridges at Yvré l'Evêque on the right, and a small one near Parance in the centre. The forest of St. Hubert covered all the ground in front up to the Connerré high road, about 1300 yards from the general crest-line of the heights.

The Germans, advancing along the St. Calais road to protect the right of their attack on Changé, numbered 5 battalions, $3\frac{3}{4}$ squadrons, and 18 guns. A flanking detachment of 1 battalion, 2 squadrons, and 4 guns, was at La Belle Inutile, opposite Pont de Gennes, in the early morning, and $\frac{3}{4}$ of a battalion were sent to St. Mars-La-Bruyère to maintain communication with it; but before noon the detachment withdrew to Soulitré, and did not regain the Connerré road till near dark.

The main column halted at the farm of St. Hubert des Rochers, 4 miles from Ardenay, and about 1½ miles from the French position, as the fighting to the south sounded far in rear. It was at Parigné l'Evêque, 5 miles off to the southward, and the French line commanding the St. Calais road faced south-east.

At 1 p.m., the French attack along the road; and the Germans, while deploying 1¼ battalions to stop this advance, also take the offensive with ¾ of a battalion towards the village of Champagné, St. Mars la Bruyère having been captured by them an hour previously.

The fight becomes general along the line, while sounds of battle can be heard at Changé, 2½ miles S.W., and near Connerré, 9 miles N.E. After a time Champagné is taken from the Breton Corps, and 2 German guns, sheltered by a slight rise of the ground on the road just west of St. Hubert, succeed in silencing the French guns placed near the Lune d'Auvours. The Germans then advance along the road, and Paris's men, fatigued by two night marches and dispirited by their unsuccessful fight at Ardenay on the 9th January, give way. This uncovers the Breton right, and, in consequence, the whole French force retires towards Yvré l'Evêque. At dark the Germans hold Champagné, and their outposts line the railway thence to Lune d'Auvours.

The ¾ of a battalion who had captured St. Mars-la Bruyère being joined by the flanking detachment from Soulitré reached Champagné about 6 p.m., and, in consequence, the Germans were strong on the right. By some mistake, however, Champagné was evacuated in the night, and the French taking heart again, and probably fearing Chanzy's bitter reproaches, again re-occupied the whole of the Auvours Heights and the village of Champagné.

AUVOURS HEIGHTS.

11th January.

When, early on the morning of the 11th, General de Chanzy passed along the line to cheer his men, the morning was bright and clear. The French troops on the Avours Heights, numbering about 16,000 men, with 30 guns and some mitrailleuses were distributed on a front of about 7,000 yards. The flanks were protected by 12 guns of position, divided between St. Croix on the left, and Le Luard on the right. The approach to Yvré l'Evêque was swept by two Gatling guns placed in battery on the right of the Huisne, just below Le Luard, and the protection of a retreat towards that flank was secured by sunken batteries sweeping the broad plateau at the western end of the heights. The Germans at first numbered 6¾ battalions, 5¾ squadrons, and 22 guns, but the 9th Corps was hastening up from Ardenay, and this consisted of 11¾ battalions, 4 squadrons, 48 guns, and a light bridge train. In all about 15,000 men and 70 guns.

About 10 a.m., the fight begins at both ends of this section of the line. The Germans, with 1½ battalions supported by 4 guns, attack

Champagné, and the French open fire from Le Luard on a column of Germans turning the northern end of the Changé ridge, and also threaten to attack it from the west end of the Auvours Heights. The German attack is made more with a view of protecting the right of their troops about Changé than of capturing the French position.

At 11 a.m., Champagné is carried after a fierce street fight, and a battalion is sent forward against the French right by Lune d'Auvours.

Neither side makes much advance during the next hour, and the Germans receive anything but good news as to the progress of their attack near Changé, but at noon the Advanced Guard of the 9th Corps, consisting of 4 battalions, 4 squadrons, and 12 guns, reaches the ground, and enables them to send 3 battalions, 1 pioneer company, 4 squadrons, and 14 guns to the south by Auvigné to help the Division they belong to in its fight north of Changé.

The battle remains almost stationary for another hour while the German reinforcements deploy, but at 1 p.m., 3 battalions and 12 guns of the Advanced Guard join the 1½ battalions in Champagné, and ascend the heights by a sunken road, full of snow, just west of the village, the French having abandoned all the open part of the eastern end of the heights, and retired towards the bridge near Parance. The farm of Les Haut Taillis is, however, still held strongly.

The Germans reach the spur, jutting out to the south-east, east of the Villiers ravine, and their guns come into action on it. Above Villiers are 3 mitrailleuses commanding the narrow *col.* between Le Haut Taillis and Le Chêne, and stopping the advance westward; some Infantry creep up to within 50 yards, and then with a rush capture them, but lose their gallant leader. While this takes place the other battalion of the Advanced Guard of the 9th Corps has replaced the one at Lune d'Auvours, which has been despatched to the southward.

Champagné, during the advance, has been left unoccupied, and this being perceived by the French near La Croix on the opposite side of the river, an advance is made by them to retake this important passage, but the Germans, who have once already suffered severe loss in its capture, see the movement from the top of the hill, and race down again to keep their prize. A quarter of a battalion reaches the bridge in time and repulses the French attack. Another quarter of a battalion establishes itself securely on the eastern end of the heights and three quarters of a battalion moves round by the left bank of the Huisne, and clears the low ground on the right of the attack.

About this time Les Arches Chateau, in the valley of the Huisne between the Auvours Height and the Changé ridge, has been re-occupied by the French, when left by the Germans called to the help of their comrades further south, but again captured by the force sent southward on the arrival of the 9th Corps. The village of Villiers has been abandoned by the French.

At 2 p.m., 10 German guns open near Les Arches Chateau, but are soon silenced by the heavy guns at Le Luard, and the French advance from the direction of Yvre l'Evêque. The battalion relieved at Lune d'Auvours is, however, in time to take this movement in flank, and the battle again becomes stationary.

At 3 p.m., the main body of the 9th Corps arrives on the ground, and a serious attack is made on the French position. 2½ battalions still left free on the eastern end of the heights, advance on Le Haut Taillis, and on the German left the battalion at Lune d'Auvours sends half its strength to Villiers to join in the fight.

The fresh arrivals send 2 battalions straight against the centre of the heights, and support them by the fire of two batteries under escort of a squadron, from the junction of the Villiers road with the main Connerré highway. Three-quarters of a battalion in the front line carry the small collections of cottages called La Gacheterie and Le Chêne.

The half of a battalion at Lune d'Auvours, being relieved by a fresh one, pushes on, and succeeds in reaching and holding the Polucan copse. A quarter of a battalion skirmishes north of Lune d'Auvours, while three quarters of a battalion creep up through the enclosures and rush into the sunken batteries on the western end of the heights, their left being protected by another quarter of a battalion.

Le Haut Taillis is at length captured after an obstinate fight of 2½ hours, and soon afterwards Les Filles Dieu, on the reverse slope, also changes hands.

At 5.30, the Germans hold the western edge all along the heights. A battalion of Mobiles makes an attempt to gain the southern plateau from Yvre l'Evêque, but is driven back and loses many prisoners to the German troops in Polucan copse.

It is dark and the day seems fairly won, when favoured by the obscurity and the screen of copse wood on its right, a column of 2000 sturdy Bretons, led by General Gougeard in person, climb the steep slopes by Les Filles Dieu, and make such a determined and impetuous onslaught, that the tired Germans give way, and the western edge of the southern half of the heights again passes into the hands of the defenders. This brave charge, though successful, is rendered useless in the end, by the disaster which befalls the National Guards, from the same province, on the Chateau du Loir road three hours later, which necessitates the general retreat of the whole French Army in the forenoon of the 12th January.

During the night, the Germans hold the open north-east end of the Auvours Heights; and, to secure the Champagné bridge, send across the river 3 battalions with 6 guns, placing strong outposts near La Croix and La Monpointière.

If the Huisne had been sufficiently bridged behind the Changé ridge on the French right, and their left had been withdrawn to the prepared position west of Savigné, the state of General de Chanzy's Army, then the best hope of France, would have been far from desperate.

To see the ground, take train to St. Mars la Bruyère. Cross the rails 150 yards up the line (N.E.) and the river at the Bourrai Mill. In 1871, there was only a succession of foot bridges, and these may have been destroyed, but a new masonry bridge has just been completed.

St. Mars la Bruyère is a large but compact village (1600 inhabitants) lying on each side of the Connerré high road. On the opposite side of the river is a low ridge commencing at La Croix, forming a sort of connecting link between the Auvours Heights and those of Montfort on the right bank 2 miles north-east. This ridge was weakly held by the French to maintain the connection with the 21st Corps on their extreme left.

Ascend the hill and turn to the left (W.) along a country lane. The end of the ridge is the probable position of the French guns of position protecting the left of their troops on the Auvours Heights. These, it will be seen, are of considerable altitude, and are separated from the ridge you are on by the River Huisne, which breaks through, and then makes a long loop to the westward round the Auvours Heights, cutting off from the high ground north-west of Le Mans. Keep on due west until a good road, leading northward, is reached, and then turn left (S.).

At Champagné, the old bridge and the village nestling against the almost perpendicular hill on the left bank of the river, which falls over a tall weir under the bridge into a large circular basin full of eddying currents, form a charming landscape. (The factory on the right (N.) bank is believed to be of recent date).

Champagné itself is a stone village (about 600 inhabitants) with narrow streets, built in a triangular shape, with its apex at the bridge, and its base to the south-east. The church is a plain building near the centre, and it was here that the fiercest fighting took place.

At the church, keep to the right and pass right through the village, until the hollow road by which the German troops mounted the hill is reached. Then keep on due west, bearing away to the right, so as to reach the highest point at the eastern end of the ridge. Here the view is magnificent, but it is only necessary to particularly note the country to the north, as a better point of vantage for that towards the east and south-east will be obtained shortly.

Looking a little to the N. of E., the most striking object is the Chateau de Montfort, the large white building above Pont de Gennes. Beyond this is the fir plantation on the south-east end of the Loresse last-named ridge. N.E. at the other end of the ridge, which marks the front of the French 21st Corps on the evening of the 11th January, is the village of Lombron (1400 inhabitants). Beyond Lombron is the low ground where is the village of Chapelle St. Rémy, the right of the German attack on the same day. More to the left (N.) is the high bluff running out boldly from the north-east into the timber-covered plain round Savigné; this is the Sillé St. Philippe ridge, which village, with its fine church, is seen on its southern slope.

Chanteloup, the site of a small engagement on the evening of the 10th of January, and the position across the Bonnétable road, where Villeneuve's Division of 21 French Battalions was kept inactive during the whole of the battle, is on the end of this ridge. With good glasses the lines of poplars bordering the Bonnétable road can be seen stretching right across the broad valley, past Savigné, whose slate church tower shines in the sun, to the line of heights, running in a

north-westerly direction from opposite the centre of the Auvours position, which bounds it to the south-west.

This line of Heights had been prepared for defence, has fairly open slopes, with low ground in front extremely difficult to traverse. Before the French left, however, fell back on this strong position, the right had been pierced and the whole Army was obliged to retreat to the north-west.

Pass along the crest-line of the Heights to Le Haut Taillis farm. It will be seen that the whole of the north-eastern end of the position is occupied with vineyards, and is quite open, but Le Haut Taillis is surrounded with trees and small enclosures, and that, west of this, the vines only grow on the lower part of the south-eastern slope. This explains how the raw French troops on both days quickly gave way on their extreme left, but on the second day fought obstinately and well in the enclosures more to their right.

Passing on to the spur, east of Villiers, it is clear that the timber must have screened the German guns from the fire of Le Haut Taillis, or they could not have come into action at this place.

On the top of the spur a narrow belt of bushes runs out to its shoulder. Just at the end of these bushes, by a young fruit tree, the whole French position can be more or less seen on a clear day, and also the sites of the actions in advance on the 9th of January. It is for this reason that the account of this part of the action is given last. After many trials it is believed to be the best point of vantage on the whole ground.

Facing south-east towards the railway, you have before you the large plain of the forest of St. Hubert, now cleared of trees, except to the east of St. Mars la Bruyère. Far up the Huisne valley on its left bank lies the village of Duneau, nearly 10 miles off; this marks the end of the fighting of the German right column on the 9th. Opposite to you, 5½ miles away, is the large white Chateau of Ardenay, where the centre column fought on the same day. Nearly 7 miles to the south is Parigné l'Evêque, marked by a bright red roof at the top of the village; here the fighting commenced on the morning of the 10th.

Between the Duneau ridge and Ardenay are wooded slopes, culminating in the high point of St. Denis du Tertre, behind which lies a much enclosed and timbered country. Between Ardenay and Parigné l'Evêque, there is a ridge covered with the large forest of Loudon, but the St. Hubert Plain and the low ground between Parigné and the Changé ridge, are separated by the low wooded ridges of Rossay and Beauvais, dividing the valleys of the Narais river and of the Gué Perray brook.

To realize the extent of ground over which the French were spread during the actual battle, we will begin from their extreme left. This, marked by the high bluff of Chanteloup, can be seen through a gap in the trees round Le Haut Taillis; it is rather over 6 miles off to the north. On your left up the Huisne valley, over Pont de Gennes church spire, can be seen a line of poplars; they are on the road from

Connerré town to Connerré station, and are over 8 miles from you. From Chanteloup to Connerré station is 7 miles, and on this front the French left wing faced north-east on the 10th January.

From that point to Champagné the right of the Huisne was weakly held. The line then crossed to the left bank, and from Champagné to Le Luard on the right bank again, 3 miles on your right, the centre of the French Army was fairly strong. Thence the line again crossed the Huisne valley to the low fir-clad ridge, whose reverse slopes are open to your view. At first, there were only weak detachments in the gap formed by the Huisne, but the right wing rested its left flank in strength on Changé, whose church spire, with its clock, stands out amongst the trees, 2 miles south-east of Le Luard, and 3 miles south-west from you. Following the crest line to the right (S.W.) from Changé, a small building resembling a chapel, and what appears a tall poplar, will be seen on its highest point. These are the Villa, called La Tuilerie (or Le Fouillet) on the Chateau-du-Loir road, where the line was pierced on the evening of the 11th January, and a factory chimney near it. This point is 3 miles from Changé, and 6 miles from you, but the French position extended 3 miles further on to the village of Arnage on the Sarthe.

Thus, General de Chanzy, with his 100,000, 120,000, or 140,000 men, fought the battle, which was to decide the fate of France, on a line 26 miles long, crossed twice by the River Huisne, and with gaps between the more compact bodies of 6, 7, and 2 miles. Even on the second day, taking Lombron and La Tuilerie as the extreme flanks, the line as the crow flies is 12 miles.

The Germans on the 10th of January attacked this position with, at the most 33,000 men and 100 guns, on a front of about 14 miles, in three bodies, between which were gaps of 8 miles and 1 mile. On the afternoon of the 11th, their force was increased in the centre by, at the most, 8,000 men, and on the left by 15,000, making in all 56,000 men, their front extended over 16 miles, and there were gaps in it of 4½ miles and 2½ miles.

On the 10th, the German right was fighting 8 miles away on your right, the centre close up to you from Champagné to Changé, the left was far away beyond Parigné l'Evêque, and the reserve of about 8,000 men, and 54 guns reached Ardenay.

In the forenoon of the 11th, the right came about 2 miles nearer, the reserve came up on the right of the centre and gained your position, the centre was round Changé, and the left approached along the Chateau du Loir road.

On the 12th, the left and centre swept over the low Changé ridge down into Le Mans, the reserve secured all the heights you are on, while the right carried on a running fight to the north of you as the French retired westward. The battle had been lost and won, and France had soon to submit to the stern demands of her conqueror.

Villiers, a small village, lies on your right in a deep ravine, which nearly cuts the heights in two. The front slopes of the position are

of a rounded-down-like form, while those in rear will be found to have a steep uniform gradient from top to bottom.

Return to Le Haut Taillis and turn left (W.) down the lane leading along the crest-line. The *col* joining the open eastern end with the enclosed western one is found to be very narrow, and an attack along it would have been difficult if the mitrailleuses had not to be captured by that gallant rush. The rear of the position will be found covered with enclosures with large hedge rows.

At Point d'Auvours, a collection of cottages where a good road to Yvré l'Evêque commences, keep to the left and pass round the shoulder of the heights until the monument, erected to the men who fell in this last effort for their country, is reached. Here must be the position of the sunken batteries, though the copse wood has grown since the day of battle, and now shuts out the view over the plateau.

Descend to Yvré l'Evêque by joining the road from Point d'Auvours. On the right near the bottom is the small farm of Les Filles Dieu, where the steepness of the slopes attests the energy of the Breton charge.

The old bridge, north of Yvré, is only second in picturesqueness to that at Champagné.

Proceed right through Yvré, and just beyond the position of the guns and mitrailleuses near Le Luard is reached. Here it will be seen why the Germans could not advance beyond the Polucan copse, as its western edge is just on the crest of the low spur running down the left of the Huisne from the Auvours Heights, and the ground between it and the river is open and commanded. Les Arches Chateau and that of Les Noyers, with its bridge a little further down are thoroughly exposed; and their capture, and retention by the Germans, tend to prove that even heavy guns cannot be trusted to close gaps in a line, unless the more important spots in them are firmly held by Infantry.

The road leads straight into Le Mans along the right of the Huisne.

The whole walk is about 12 miles.

FINIS.

THE ART OF WAR IN THE MIDDLE AGES.

A REVIEW:

BY

MAJOR H. W. L. HIME, R.A.

"The Art of War in the Middle Ages, A.D. 378–1515;"

BY

C. W. C. OMAN, B.A., OXON; FELLOW OF ALL SOULS COLLEGE.

THE above is the title of the Oxford Lothian Prize Essay for 1884; an Essay which is instructive and interesting, and in one respect, we believe, unique. It is the first occasion, so far as we are aware, on which a civilian has betaken himself to the task of writing upon the Art of War. We have to congratulate ourselves that Mr. Oman has performed this exceptional labour. He is happily untainted by military prejudices,—by what M. Thiers has called "nos séculaires traditions militaires"; and his Essay is so learned, and at the same time so able, that no soldier can read it without profit. In the course of this review we shall have to differ from Mr. Oman on several points; but this does not in the least blind us to the value of the service he has done the Army, in throwing so clear a light upon a very dark period in the history of the Art of War.

The period which Mr. Oman deals with stretches from the battle of Adrianople to the battle of Marignano, and embraces the rise, development, and fall of Feudalism. "There is a point of view," he says, "from which its history could be described as 'the rise, supremacy, and decline of heavy Cavalry as the chief power in war.' To a certain extent the tracing out of this thesis will form the subject of our researches." That during this period the Cavalry became the chief power in war is beyond all denial; but it appears to us that this was owing, not to the rise of the Cavalry, but to the fall of the Infantry. The rise of the Cavalry was only relative; the fall of the Infantry was absolute; and we should prefer to alter the phrase quoted above to, "the decline, fall, and revival of the Infantry."

Every army must be a more or less accurate reflection of the nation it belongs to. The image is perfect when the mode of recruiting is

Universal Conscription: it is least accurate and representative when the mode of recruiting is voluntary enlistment. Whatever may be the mode of recruiting, however, there can be no doubt of the truth of M. Fustel de Coulange's aphorism—"l'état social et politique d'une nation est toujours en rapport avec la nature et la composition de ces armées."[1] Changes, then, in the social and political state of a nation will be surely accompanied by corresponding changes in the state of the army; and it has been noticed by several writers that the rise, or decline, of Infantry depends upon the rise, or decline, of democracy.[2]

During the palmy days of Greek democracy, the phalanx, the Infantry, was supreme. In the progress of time, however, the power of democracy waned; the Infantry waned with it; and it was with his Cavalry, rather than with his Infantry, that Alexander conquered Asia.

As the Infantry was supreme in democratic Greece, so it was paramount in democratic Rome; and, in a similar manner, the decay of the Roman Infantry accompanied the decay of democratic principles. The power of the Roman Infantry expired with Roman freedom: with the disruption of the Carlovingian Empire regular armies disappeared altogether.[3] Military concentration was impossible in an age of "political dispersion."[4] The central authority was too feeble to co-ordinate and regulate the forces which were nominally under its control, and the situation is best described in the words of the Biblical writer:—"in those days there was no king in Israel: every man did that which was right in his own eyes." The Lord and his vassals, during the 9th and 10th centuries, may be considered as a patriarchal household, and in time of war each of these households formed an armed band. An army was formed of a number of these independent bands, each headed by a noble who was a law to himself and his retainers, and who was impatient of all command or control. In these armed crowds, therefore, there was none of that cohesion, that discipline which is the soul of armies.[5]

During the latter part of the Middle Ages, whatever government there can be said to have been, was purely aristocratical; and the power of the Cavalry was paramount, while the Infantry grovelled in the dust.[6] But the slow rise of democracy was closely followed by the rise of the Infantry service. "In the fourteenth century," says Mr. Oman, "after a thousand years of depression and neglect, the Infantry at last regained its due share of military importance."[7] The Flemish

---

[1] "La Cité Antique."

[2] In the good, not in the bad, sense of the word. Condorcet, "Tableau de l'Esprit humain," p. 144: Thiers, "Hist. du Consulat et de l'Empire," XX., 735, et seq.: Lecky, "Hist. of Rationalism," II., 213: and, I believe, Cibrario, "Economia del Medio Evo;" tom. I.

[3] Oman, p. 49.

[4] "Dispersion politique"; Aug. Comte, "Philosophie Positive," V., 275. "During the Middle Ages the combining power of men often failed: in a divided time you cannot collect as many soldiers as in a concentrated time." Bagehot, "Physics and Politics," p. 46.

[5] Oman, p. 15.

[6] *Ibid.*, p. 54.

[7] *Ibid.*, p. 62.

burghers, fighting for their liberty, brought this service to some state of efficiency; and the battle of Courtray is famous as the first battle, north of the Alps, won by townspeople over the nobles. And "almost simultaneously there appeared two peoples asserting a mastery in European politics by the efficiency of their foot-soldiery. Their manners of fighting were as different as their national character and geographical position, but although they never met either in peace or war, they were practically allied for the destruction of feudal chivalry." They were practically allied, in truth, for the defence of freedom against despotism. "The knight, who had so long ridden roughshod over the populations of Europe, was now to recognise his masters in the art of war. The free yeomenry of England and the free herdsmen of the Alps were about to enter upon their career of conquest."[1] Well, then, may Thiers call Infantry, "l'expression du developement des peuples." The development of liberty was accompanied by the development of the Infantry, and its progress has been almost uninterrupted from the days of Creçy and Poictiers, of Morgarten, Laupen, and Sempach down to our own time.

Mr. Oman (pp. 4, 5) attributes the gradual increase of the Roman Cavalry, after Rome had adopted a purely defensive policy, to the necessity of being able to move rapidly from point to point of the frontier; to the improved tactics of the barbarians; and to the deterioration of the Roman Infantry. Broadly, the situation seems to have been this. At the period in question, the Western Empire was confronted by enemies who fought chiefly on foot; it was against inroads of Cavalry that the Eastern Empire had to be on the alert.[2] Such a state of things naturally produced a tendency, in the Eastern Empire, to increase the Cavalry arm. Furthermore, the Barbarian recruits, whom it became necessary to enlist in ever-increasing numbers as the Greeks became more and more unwilling to serve in the defence of their country,[3] were for the most part born-horsemen, from the valley of the Danube and the Ukraine, whom it would have been impossible to convert into foot-soldiers. Lastly, the miserable Greek was becoming daily less fit, morally and physically, to endure the fatigues of service in the field on foot.[4]

---

[1] Oman, p. 62. According to Henry of Huntingdon, William the Conqueror reproached the English for their want of the long-bow. A century afterwards they began to evince that skill in archery which eventually gave them such celebrity. At the siege of Messina by Richard Cœur-de-Lion, as we learn from Richard of Devizes, the Sicilians were forced to leave the walls unmanned, "because no one could look out of doors, but he would have an arrow in his eye before he could shut it." Up to the middle of the 11th century the Cavalry was an unpopular service in England. "In 1055 the alien Captain of the garrison of Hereford, Raulfe, directed the English to serve on horseback; which, says the chronicler (Roger de Hoveden, *sub an.* 1055), was contrary to their usage; 'Anglos *contra morem* in equis pugnare jussit.'" "Ancient Armour in Europe," by John Hewitt; I. pp. 157, 17.

[2] Die Kraft der germanischen Heere besteht im Fussvolk; die Völker des Ostens sind vorherrschend Reitervölker; das germanische Fussvolk führt vorherrschend Nahwaffen, die morgenländischen Völker die Fernwaffe, den Bogen. Rüstow, "Geschichte der Infanterie"; I., 58.

[3] In the time of Leo, the Imperial forces were composed of every nation contained within the limits of the realm, except the Greeks.—Oman, 41.

[4] Robertson, "Hist. of Charles V."; I., 66.

It was about this time that the Infantry began to lay aside their defensive armour; a trivial matter at first sight, but one which really involved, as Rüstow has pointed out, an entire transformation of the old Infantry Tactics.[1] Mr. Oman admits the fact, but he rejects the account given by Vegetius of this important movement. Vegetius says, that when regular military exercises ceased, from sloth and negligence,[2] the soldiers asked and obtained permission from the Emperor to discard, first, the cuirass, and eventually, the helmet, their arms beginning to seem heavy because they seldom put them on. "Vegetius," says Mr. Oman, (p. 9) "often more of a rhetorician than a soldier, has evidently misstated the reason of the change." To us it is far from evident that Vegetius has misstated anything. "At a time when Cavalry were clothing themselves in more complete armour," adds Mr. Oman, "it is not likely that the Infantry were discarding it from mere sloth and feebleness." But surely it is not a question of what is likely, or what is unlikely. If every unlikely event in history were to be summarily excised, there would be very little history left to us. The question is, are we to receive as true a certain statement made by Vegetius, a contemporary writer, about the Roman Army?—a statement accepted by Gibbon,[3] Robertson,[4] and Maizeroy.[5] We say, yes: there is no sufficient reason to doubt the veracity of Vegetius. Even in the present day soldiers, especially young soldiers, have to be exercised weekly in marching order, for the very reason mentioned by Vegetius: their accoutrements would seem heavy if they seldom put them on. On the other hand, we can see no grounds for accepting the reasons suggested by Mr. Oman himself for the change in question:—the despair felt by the soldiery of "resisting horsemen any longer by the solidity of a line of heavy Infantry," and the feeling that for the future Cavalry must be resisted by missiles—"a method . . . even more efficacious than that which they abandoned." Degraded as the mediæval Infantry may have been, it is impossible, without strong positive evidence, to believe that they proclaimed aloud their own impotence. The pretext they made, according to Vegetius, for discarding their armour, was no doubt a false one; but at least it threw a veil over their shame. They discarded their armour for the same reason they discarded the phalanx, and the legion, and all that pertained to them—utter demoralisation.

"You have the Pyrrhic dance as yet,
Where is the Pyrrhic phalanx gone?"

Gone, except in name, with the men that formed it. The phalanx, the legion, were suitable only for men; they were totally unfitted for the tamed and demoralised barbarian of the West, or the cringing Byzantine slave of the East. As to resisting Cavalry with missiles,

---

1 "Geschichte der Infanterie"; I., 52.

2 "Interveniente negligentia desidiaque"; "De Re Militari"; I., 20.

3 "Decline and Fall," &c.; III., 404–5.

4 "Hist. of Charles V.;" I., 5.

5 "Institutions Militaires de l'Empereur Leon," Paris, 1771; préface, p. xv.

everything depends upon the missile. That no missile known for 1000 years after Vegetius' time [1] could stop a charge of Cavalry so surely as a firm line of pikes, was triumphantly proved by the Swiss, centuries afterwards. The Cavalry might surge against the phalanx, and dash itself upon the pikes; but only to be driven back like a broken wave. With archers it was far different: they were incapable of resisting a charge of mailed horsemen, and their tactical arrangements prove that they understood this. In the first place, the bands of archers were invariably supported by bands of pike or spearmen, behind whom the archers took refuge in the moment of need. Secondly, each archer carried a stake which was firmly planted in the ground some yards to his front; and these stakes, when strongly connected by ropes, formed a dangerous obstacle to Cavalry advancing to the attack.[2] So well-known were these palisades, that Shakespeare speaks of them in one of his plays:—

> "He wanted pikes to set before his archers;
> Instead whereof sharp stakes, pluck'd out of hedges,
> They pitchèd in the ground confusèdly,
> To keep the horsemen off from breaking in." [3]

The mailed horseman eventually disappeared from the battle field; but he was driven from it by the musket, not the bow. The archer was the first victim of the musketeer; the knight the second. The pike maintained its position for centuries, and was not wholly supplanted by the bayonet until the beginning of the 18th century.

The truth is, the missile was, at the period we speak of, the chosen arm of the coward who refused to come to close quarters. It could be used at a distance; it could be used in flight; and the degenerate Greek of the Lower Empire was doubtless beginning to

---

1 Vegetius' work is "dedicated to one of the Emperors who bore the name of Valentinian," says Mr. Oman, "probably to the second, as (in spite of Gibbons' arguments in favour of Valentinian III.) the relations of the various arms to each other and the character of their organisation point to a date prior to the commencement of the fifth century" (p. 9). The only arguments Gibbon brings forward are contained in the following words:—"The series of calamities, which Vegetius marks, compel us to believe that the *Hero* to whom he dedicates his book is the last and most inglorious of the Valentinians."—"Decline and Fall, &c."; III., 405, *note*. It was hardly worth while raising a question about an interval of only 33 years; but it seems to us that it was safer to form a judgment from the "series of calamities," which are undeniable, than from the "relations of the various Arms and the character of their organization" in a time of transition and confusion. The jumbling together of military terms and formations with which both Gibbon and Mr. Oman charge Vegetius and other military writers, was probably not so much the fault of the writers as of the time they lived in. The Roman armies at this period consisted, more or less, of a medley of different nationalities, each of whom fought after their own fashion; and to evolve order out of such disorder was all but impossible. Speaking of the time of Julian, Maizeroy says the legions still existed, "mais la forme en était changée; on ne reconnaissait plus rien ni aux armes, ni à l'ordonnance, ni à la manière de combattre: c'était un mélange de tous les usages des barbares qui les composait."—"Inst. Mil. de l'Empereur Leon"; préface, p. XVII.

2 Rüstow, "Geschichte der Infanterie;" I., 105-7.

3 Henry VI.;" Part I., Act I., Sc. 1.

The proposal of Ubricius to supply the (so-called) legions with stakes (Oman, p. 5), only proves that that tactician thoroughly understood the innate incapacity of missile weapons, which were then spreading in Roman armies, to withstand Cavalry attacks.

display those qualities which afterwards attracted the notice of a poet :—

> " Swift in attack they rush, and swift in flight,
> In troops retreating and dispersed they fight."[1]

After the foregoing remarks, it is needless to say that the rise of the mediæval Cavalry appears to us to have been only relative, not absolute. The foot-men over whom this Cavalry triumphed were a wretched and beggarly mob, called Infantry by courtesy only; and there is little, or nothing, to justify us in placing the great mass of the horsemen above the level of second class Cavalry. The best cannot claim equality with the Cavalry of Hannibal :—that Cavalry whose action was so swift, so sure, so terrible, that in reading of them one is reminded of the 'two-handed engine' of Milton :—

> " —— that two-handed engine at the door
> Stands ready to smite once, and smite no more."

It is not clear what Mr. Oman's opinion is upon this question. In any case, he cites the battle of Adrianople as "the first triumph of the mediæval horsemen . . . . the first great victory gained by that heavy Cavalry which had now shown its ability to supplant the heavy Infantry of Rome as the ruling power in war"—(pp. 2, 7). We do not read the battle of Adrianople as Mr. Oman reads it: to us it teaches no lesson that had not been taught six centuries before. To establish this point, let us make a detailed comparison of the battles of Cannæ and Adrianople :—

CANNÆ, 2ND AUGUST, B.C. 216.

(1). The Romans passed the summer night before the battle "in the burning Apulian plain without water."[1]

[1] Arnold, "Hist. of Rome;" III., 137.

ADRIANOPLE, 9TH AUGUST, A.D. 378.

(1). The Romans marched 12 miles to the battle-field over bad roads,[1] and were then delayed for a considerable time, by mock negotiations, amidst blazing underwood and under a burning sun.[2] When the Infantry began the battle, therefore, they were exhausted by heat, hunger, thirst, fatigue, and the weight of their arms.[3]

[1] "Decursis itaque viarum spatiis confragosis."—Ammianus Marcellinus; XXXI., 12, 11.

[2] "Gothi de industria cunctabantur ut . . . miles fervore calefactus æstivo, siccis faucibus commarceret relucente amplitudine camporum incendiis, quos lignis nutrimentisque aridis subditis, ut hoc fieret, iidem hostes urebant. Cui malo aliud quoque accedebat exitiale, quod homines et jumenta cruciabat inedia gravis."—Ammianus Marcellinus.

[3] "Solque sublimior decursu Leone ad domicilium cœlestis Virginis transiens, Romanos magis attenuatos inedia sitique confectos, etiam armorum gravantibus sarcinis, exurebat."—Ammianus Marcellinus.

[1] "Nell' assalir son pronti e nel ritrarsi,
E combatton fuggendo erranti e sparsi."—
Tasso, "Ger. Lib."; c. I., st. 50.

The Duke of Wellington once unwittingly parodied these lines in a very angry letter :—"—— have acquired a trick of galloping at everything, and then galloping back as fast as they galloped on."—"Characteristics of the Duke of Wellington," by Earl de Grey, p. 183.

CANNÆ, 2ND AUGUST, B.C. 216.	ADRIANOPLE, 9TH AUGUST, A.D. 378.
(2). The strong south wind, Volturnus, swept its clouds of dust into the faces of the Romans.[1]	(2). The Romans were eventually unable to see the heavens from the clouds of dust.[1]
(3). The Roman Army was formed up with the Infantry in the centre, and the Cavalry upon either flank.	(3). The Roman Army was formed up with the Infantry in the centre, and the Cavalry upon either flank,—the right wing thrown forward.
(4). The Light troops opened the battle, and eventually retired without any advantage being gained by either side.[2]	(4). The Roman Light troops suddenly attacked the Goths, without orders and before the negotiations were finished. They were defeated and fled.[2]
(5). The Carthagenian left wing Cavalry charged and routed the Roman right wing Cavalry.	(5). Gothic Cavalry charged Roman right wing Cavalry, who fled.[3]
(6). Circling to the right round the rear of the Roman Infantry, the Carthagenian left wing Cavalry now attacked the right rear of the Roman left wing Cavalry, which was already engaged in front with the Carthagenian right wing Cavalry. The Roman Cavalry fled.	(6). The Roman left wing Cavalry advanced up to the laager of the Goths; but being unsupported by the right wing Cavalry, and attacked probably by both the guard of the laager and the Gothic Cavalry, it was defeated and fled.[4]

Cannæ:

[1] Livy; XXII., 43.

[2] Polybius; III,, 114.

Adrianople:

[1] "Nec jam objectu pulveris cœlum patere potuit ad prospectum."—Ammianus Marcellinus. Need we say that the Roman Infantry were half-beaten before the battle began?

[2] "Sagittarii et scutarii . . . avidius impetu calenti progressi, jamque adversis conexi, ut immature proruperant, &c."—Ammianus Marcellinus.

[3] "Equitatus Gothorum . . . . reversus, Halanorum manu permixta . . . quoscumque adcursu veloci invenire comminus potuit, incitata cæde turbavit."—Ammianus Marcellinus.

[4] "Sinistrum cornu adusque plaustro ipsa accessit, ultra (si qui tulissent suppetias) processurum: a reliquo equitatu desertum, multitudine hostili urgente . . . oppressum atque dejectum est."—Ammianus Marcellinus.
"Alors toute la Cavalerie tourna le dos, et ce fut la principale cause de la défaite."—Lebeau, "Hist. du Bas-Empire;" III., 135.

CANNÆ, 2ND AUGUST, B.C. 216.

(7). Whether by accident or design, the Roman Infantry had advanced with both flanks thrown back. The Carthagenian Infantry now closed with it from the front and both flanks, driving the refused wings inwards upon each other. Its huge masses were "already weltering in helpless confusion, crowded upon one another, totally disorganized,"[1] when the Carthagenian left wing Cavalry "broke with thundering fury upon their rear."[2] The Roman Infantry, surrounded on all sides, and unable either to fight or fly, were cut to pieces.

[1] Arnold, "Hist. of Rome;" III., 141.

[2] *Ibid.*, 142.

ADRIANOPLE, 9TH AUGUST, A.D. 378.

(7). The Infantry of either side were closely engaged, when the Gothic Cavalry, relieved of the presence of the Roman Cavalry by its flight, charged the Roman left wing and drove it in upon the centre in "helpless confusion."[1] In a few minutes the Roman Infantry were "one indistinguishable mass. . . . Wedged together in a press that grew closer every moment."[2] So great was the crush that men could not draw their daggers, nor raise their hands to strike.[3] The Roman Infantry, surrounded on all sides, and unable either to fight or fly, were cut to pieces.

[1] Oman, 6.

[2] *Ibid.*

[3] "Steterunt improtecti pedites, ita concatervatis manipulis, ut vix mucronem exserere, aut manus reducere quisquam posset."—Ammianus Marcellinus.

We have not mentioned above that the Roman Infantry began to retreat at the very beginning of the fight, and were only stopped by the exertions of their Officers. Apart from this, however, a fact mentioned by Ammianus affords us strong evidence of the want of *moral* of the Infantry. They were terrified, he says, by the sight of some of their comrades who had been transfixed by javelins and arrows. This would have inflamed and inspirited good troops.

Had Ariosto read Ammianus when he ascribed the flight of the Greeks at the siege of Belgrade to the very same cause,—the sight of the wounds inflicted by Roger?

"Non è, visti quei colpi, chi gli faccia
Contrasto più, così n' è ognun smarrito."
—Orlando Furioso; c. 44, st. 88.

It seems to us that the lesson taught by the battle of Adrianople is identical with the lesson taught by the battle of Cannæ; namely, that an Infantry deprived of its Light troops and Cavalry will, in all probability, be destroyed by the combined attack of Light troops, Cavalry, and Infantry.

In his third chapter Mr. Oman breaks a lance with Gibbon, and indeed with most received writers, upon the subject of the Byzantines. "The vices of Byzantine armies were inherent," said Gibbon, "their victories accidental." "It would be more correct," retorts Mr. Oman,

"to call their defeats accidental, their successes normal"—(p. 28). "Who shall decide when critics disagree?" All that remains for us to do under such circumstances, is what the feeble invariably do:—join the strongest side. We have some grounds for justification, however; for the evidence Mr. Oman brings forward to clear his client's character is chiefly (if not entirely) derived from the military works of the Emperors Maurice, Leo, and Nicephorus Phocas. Surely this is taking evidence of character from the defendant's solicitor.

The works of the three Emperors are quite similar in character, and to deal with one of them is to deal with all of them. Let us enquire into the value of the best known of the three, the "Tactics" of the Emperor Leo.

The author always assumes, says Mr. Oman, "that victory will follow the banner of the Empire . . . The troops can 'go anywhere and do anything' . . . Except the Frankish and Lombard knights, no horsemen in the world could face the Byzantine 'Cataphracti,' &c., &c." (p. 29). Such assumptions were necessary, for a reason explained by Hume. "The 10th Legion of Cæsar, and the Regiment of Picardy in France, were formed promiscuously from among the citizens; but having once entertained a notion, that they were the best troops in the service, this very opinion really made them such."[1] To convince one's own troops of their incapacity to conquer a foreign enemy would be to invite, if not to ensure, defeat. "For centuries," says Mr. Oman, "war was studied as an art in the East," (p. 29). Yet does not the Emperor himself bewail the decay of courage and the universal neglect of Tactics in every chapter, if not in every page, of his book?[2]

It would be impossible here to criticise the "Tactics" in detail: we shall select two salient points; the formation of attack for Cavalry, and the Strategems.

Mr. Oman finds the formation for attack, shown and explained upon the next page, "deserving of all praise" (p. 46). We regret that we cannot agree with him. First, it is too complicated: no such intricate formation would work in the hurry and confusion of battle. The employment of so many small units proves to Mr. Oman's mind "a high degree of discipline and training" (p. 44): to our mind, we are most unwillingly compelled to say, it proves the direct contrary. An officer can command 200 disciplined troopers with far less difficulty than 50 undisciplined, or imperfectly disciplined, men: undisciplined

---

[1] "Essays, Literary, Moral, and Political"; XX.

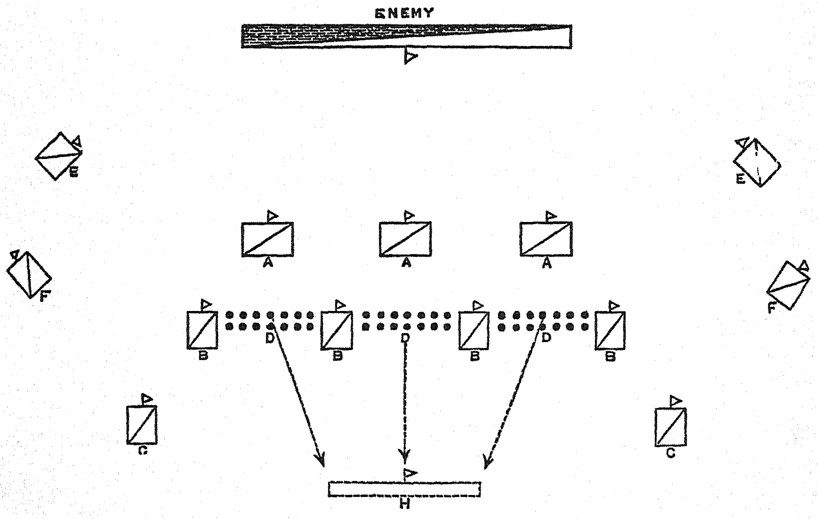
ὀυκ ἀγγελοῦμεν φαῦρ·' ἐπὲι στρατηλάτου
χρηστοῦ τὰ κρείσσω μηδὲ τ'ανδεᾶ λέγειν.

Sophocles, "Œd. Rex.": 1429.

[2] κατὰ μικρὸν γὰρ ἀμελουμένης τῆς κατὰ πολέμους ἐυταξίας καὶ γυμνασίας συνεμελήθη ὡς ἔοικε καὶ τῶν ἀριστέων ἡ ἐυψυχία; Proemium. Again, speaking of the disuse of the word, *hopliti*, he says:— μᾶλλον δὲ καὶ ἀυτοῦ τοῦ ὀνόματου, διὰ την ἄγαν τῆς τακτικῆς μελετῆς καὶ πράξεως ἀμέλειαν, παρὰ μικρόν παρὰ πάντων ἀγνοουμένου. —IV., 56.

These two sentences are as good as one hundred.

The Emperor Leo's Form of Cavalry Attack.



EXPLANATION.

A, A, A, ...	First Line, 3 Banda, of about 450 men each, on 5 to 7 ranks.
B, B, B, B, . .	Second Line, 4 half Banda, on 8 to 10 ranks.
C C	Ordinary Reserve, 2 half Banda.
D, D, D, . . .	1 Bandon, on 2 ranks, connecting the half Banda of the 2nd Line.
E E, ...	2 half Banda to turn enemy's flanks.
F F, ...	2 half Banda to secure our flanks.
H, ...	Special Reserve, formed of D, D, D, in case the 1st Line is repulsed, or the 2nd Line charged.

Cavalry cannot manœuvre in large masses. The real reason for the employment of these small units was their want of discipline, and the unwillingness of the small bands of barbaric horsemen, as they joined the Imperial Army, to be merged in troops of different nationalities.[1]

In the second place, the proposal that the connecting files, D, D, D, of the second line should move to the rear and re-form as a reserve at H, on the repulse of the first line, was the dream of a civilian. It might, perhaps, be carried out by the very best Cavalry: but a general stampede would have been the certain result with Byzantine Cavalry, who were insubordinate, and cowardly to boot. Insubordinate, for was it not these troops who murdered the Emperor Maurice for attempting to carry out some military reforms; was it not these troops who besieged the Emperor Leo in his palace, for the very same reason? Cowardly, for what was the object of the body, H? To act as a reserve, and *at the same time*, to collect stragglers and runaways:[2]—not those whose horses were running away with them, but those who were running away with their horses. And why were all the *banda* formed on not less than 5, and not more than 10 ranks? Because undisciplined troops must always be formed in deep order.

Of the strategems, ambushes, &c., on which the Emperor lays so much stress, we have only space for one example: the recommendation to address treasonable letters to the subordinate officers of the enemy's army, and to contrive that they should fall into the commander's hands, in order that he may become suspicious of his lieutenants. This is 'Byzantine,' in "the worst sense of the word," says Mr. Oman. An honest soldier would blush to suggest, deliberately, such infamy: it was the natural proposal of a Levantine whose "life was spent in the pomp of the palace, in the society of his wives and concubines."[3] How different the spirit of the ancient Greeks! "We trust not so much in preparations and strategems," said Pericles in his Funeral Oration, "as in our own courage to do what is to be done."[4]

So much for the "Tactics" of Leo, in which Mr. Oman finds "real and extraordinary merits" (p. 38). The 18th chapter, which gives an account of the modes of fighting of the adjacent nations, is interesting without doubt: the rest of the book may be said, perhaps, to be successful, if we regard it as an attempt to teach "the art of avoiding defeat, of protracting contest, of resisting attack."[5] If the Greek Empire showed some transient symptoms of revival in the 10th and 11th centuries, it was owing neither to the "Tactics" of Leo nor to the courage and vigour of its soldiers. "The vicissitudes of servitude and anarchy consummated the moral degeneracy of the

---

1 "Eine Reiterschaar irgend eines barbarischen Stammes rückt in das byzantische Heer ein, will sich mit keiner auderen zusammenthun lassen und muss also als ein Fähnlein in demselben verwendet werden."—Rüstow, "Geschichte der Infanterie"; I., 78.

2 ἅμα δε καὶ ἀναστέλλουσι τοὺς θέλοντας σκορπίζεσθαι ἢ φεύγειν.—Leo's "Tactics"; XII., 31, 38.

3 Gibbon; VI., 99.

4 Thucydides; II., 39.

5 Hallam, "Middle Ages"; II., 178.

nation . . . and this depraved people were preserved from destruction by the vices of their enemies still more than by some intrinsic resource which they yet possessed."[1] Constantinople, taken by the Crusaders in 1204, was re-taken by the Greeks in 1261; and the Empire dragged out a wretched existence until 1453. By this time, "the whole mass of the . . . population between the Danube and Mount Taurus was smitten with a moral palsy,"[2] and fell a prey to a stronger, a braver, and a nobler[3] enemy,—the Turks.

With the Byzantine Empire, we rejoice to say, our differences with Mr. Oman cease. For his Chapters on the Feudal Cavalry, the Swiss pikemen, the English archers, and his concluding remarks,—in fact the great bulk of his book,—we have little but praise. His style is agreeable; his descriptions intelligible; and his complicated narrative so skilfully put together, that we pass from one act of the drama to another without perceiving the shifting of the scenes. We cannot conclude this Review without again thanking him for having thrown so much light upon the confused and obscure "Art of War in the Middle Ages."

---

[1] Hallam; "Middle Ages"; II., 180.

[2] Finlay's "Hist. of Greece"; III., 474.

[3] "The loss of national honour and military energy arose from a general deficiency of common honesty and personal courage among the Greeks."—Finlay's "Hist. of Greece"; III., 492.

Compare the conduct of the Latin Christians after their second capture of Constantinople, 1204, (Gibbon, VII., 315), with that of the Turks after their capture of the city, 1453, (Gibbon, VIII., 176). Yet these Latin Christians were certainly not inferior, morally, to the Greeks!

PRÉCIS

AND

TRANSLATIONS.

ITALY.

I.

L'ITALIA MILITARE,

21st DECEMBER, 1884.

BY

LIEUTENANT G. E. WEIGALL, R.A.

German Field Artillery.

This number contains a translation of an article by the foreign military correspondent of the *Journal des Débats* at Coblentz, of which we give a *résumé.*

The *Militär Wochenblatt* has observed that, although in the principal European Armies the *matériel* of Field Artillery differs considerably, no system of piece possesses any marked superiority over its rivals; nor is it probable that in ten years' time this condition of things will have altered, whatever the improvements introduced. This appears just.

All technical questions of any moment may be said to have received final solutions, and every Army has reason to be satisfied with the high perfection its Artillery has attained. Fire effect and mobility are the two desiderata for modern matériel, and one can only predominate at the expense of the other. This happy equilibrium being established, the attention of Artillerymen in general, and of German Artillerymen in particular, is now being turned in another direction. In the future, other things being equal, the advantage will rest with that Artillery which shows the highest skill in laying, and the most rational mode of employment in the field.

In Germany, laying appears to be conducted rapidly, and by more simple means than are in vogue in France. Ranges are generally estimated by eye or by the map, instead of by range-finders, as is the French practice. Corrections are made after a number of rounds, which,

says the correspondent of the *Journal des Débats,* French gunners would, doubtless, consider insufficient. On the other hand, with the Germans, care is taken to fire as rapidly as three or four rounds a minute, or for each piece at least one round a minute: while the French regulations only require two or three rounds in the same space of time, and lay more stress upon accurate observation of the effect of each round. With regard to the distance at which fire is opened, this, in Germany, is not greater than the effective range of shrapnel—about 2500 metres. An improved shrapnel has however now been introduced, which will probably permit of fire up to 4000 metres. In a word, then, the German Artillery pays more attention to manœuvring capability, than to minute fire regulations and methodic choice of position.

At the recent manœuvres it was no uncommon sight to see long lines of guns (*Abtheilungen*—Divisions of three or four Batteries—or even groups of Divisions, is the rule; that of Batteries the exception) advance straight across country over all obstacles, and at a rapid pace. They appeared to lose sight of the principle that grouping is not necessary for reciprocal support, and that short advances of 1000 to 1500 metres do not give advantages to compensate for interruption of fire. On the other hand, action, *en masse,* produces such decisive results, that the German predilection for the system is not surprising.

Unfortunately, in peace manœuvres, the proportion of guns assigned to a Division is much larger than would be the case in war; so that from lack of horses, neither the reserve wagons nor the ammunition sections (*sic*) could be represented—a serious drawback to any chances of improvement in the mode of supply of ammunition to Batteries.

29th JANUARY, 1885.

Experiment in Requisitioning Horses.

With the object of rendering possible, in case of mobilization, the immediate departure of Regiments of Infantry and Batteries of Artillery, the War Minister has studied and tested a special method, without however interfering with the present requisition regulations.

The chief bases of this method are as follows:—

The animals capable of requisition are inspected on behalf of the Military Administration (*sic*), and their value is first of all determined. These animals remain with their owners, but are at the service of the Minister, who can claim them at any moment. On the instant of mobilization the price is paid, and in the meantime the owner receives an annual bonus of £2 per horse, to compensate him for the charge. On his side the owner binds himself by contract with the Military Administration, to furnish the animals within 24 hours of his receiving notice. This system was lately tested on a small scale at Rome. It was proposed to mobilize a Battery, and two Regiments of Infantry. The order, issued on a Saturday, required the supply of the animals at 11 a.m. on the next day. At 1.30 p.m. on Sunday, the Battery and Regimental wagons, completely equipped and in movement, were ready to go anywhere. The experiment is considered perfectly successful.

NOTES:

BY VARIOUS HANDS.

THE following curious letter, presented by General Sir J. H. Lefroy, brings us back to the time of Contract drivers and horses:—

WOOLWICH,
30th November, 1795.

SIR,

I am to inform you by orders from Marquis Cornwallis and Board of Ordnance, that the Horses Employed in his Majesty's service for the Brigade of Artillery under General Lord George Henry Lennox' command, are to return to the Contractor, in order to be put upon half Pay.

I am,
Sir,
Your most obedient Servant,
DUNCN. DRUMMOND.

You will please inform Lord George, or Officer Comdg.

To Col. Davis.

R.A. CRICKET MATCHES, 1885.

Monday and Tuesday ...	May 25, 26	*v.*	Free Foresters	At Woolwich.
Saturday	" 30	*v.*	N.-C. Officers, R.A.	" "
Wednesday and Thursday	June 10, 11	*v.*	B. B.	" "
Friday and Saturday	" 12, 13	*v.*	Royal Engineers	" "
Monday and Tuesday ...	" 22, 23	*v.*	Yorkshire Gentlemen	" "
Saturday	" 27	*v.*	Household Brigade	" Princes.
Monday and Tuesday ...	July 6, 7	*v.*	Harlequins	" Woolwich.
Wednesday and Thursday	" 8, 9	*v.*	Sevenoaks Vine	" "
Monday and Tuesday ...	" 13, 14	*v.*	Quid Nuncs	" "
Friday and Saturday ...	" 24, 25	*v.*	Royal Engineers	" Chatham.
Monday and Tuesday ...	Aug. 3, 4	*v.*	I Zingari	" Woolwich.
Friday and Saturday ...	" 7, 8	*v.*	R. M. Academy	" "
Monday and Tuesday ...	" 10, 11	*v.*	Royal Marines	" "
Saturday	" 15,	*v.*	N.-C. Officers, R.A.	" "
Monday and Tuesday ...	" 17, 18	*v.*	Sevenoaks Vine	" Sevenoaks.

W. E. HARDY, Captain R.A.,
Hon. Sec., R. A. C. C.

INTER-REGIMENTAL

RACQUET AND BILLIARD MATCHES.

R.A. *v.* R.E.

Played at Chatham, April 25th and 26th, 1884.

DOUBLE RACQUETS.

(*Rubber of 7 Games.*)

R.A.		R.E.
LIEUT. COOPER-KEY. / LIEUT. C. D. KING.	*v.*	LIEUT. TOWER. / LIEUT. FRIEND.
15.	... ...	6.
15.	... ...	8.
6.	... ...	15.
10.	... ...	15.
7.	... ...	15.
15.	... ...	12.
12.	... ...	15.

R.E. won 4 games to 3.

SINGLE RACQUETS.

(*Rubber of 5 Games.*)

LIEUT. COOPER-KEY.	*v.*	LIEUT. TOWER.
15.	... ...	7.
15.	... ...	7.
8.	... ...	15.
10.	... ...	15.
13.	... ...	15.

R.E. won 3 games to 2.

SINGLE BILLIARDS.

(*500 up.*)

CAPTAIN ANSTRUTHER.	*v.*	LIEUT. DUMBLETON.
101.	... ...	73.
144.	... ...	101.
201.	... ...	182.
213.	... ...	202.
219.	... ...	221.
	227 all.	
302.	... ...	233.
389.	... ...	288.
401.	... ...	289.
413.	... ...	300.
420.	... ...	321.
484.	... ...	384.
500.	... ...	398.

DOUBLE BILLIARDS.

(300 up.)

R.A.		R.E.
LIEUT.-COL. HAZLERIGG. CAPTAIN ANSTRUTHER.	*v.*	CAPTAIN DIGBY. LIEUT. DUMBLETON.
86.	... ...	82.
101.	... ...	85.
123.	... ...	99.
	149 all.	
164.	... ...	200.
200.	... ...	222.
277.	... ...	300.

The R.A. retains the Billiard Cup; the R.E. the Racquet Cup.

Played at Woolwich, April 16th and 17th, 1885.

DOUBLE RACQUETS.

(Rubber of 7 Games.)

LIEUT. COOPER-KEY. LIEUT. C. D. KING.	*v.*	CAPTAIN FRIEND. LIEUT. HAMILTON.
10.	... ...	15.
15.	... ...	12.
15.	... ...	11.
15.	... ...	5.
10.	... ...	15.
	14 all; set to 3.	
3.	... ...	0.

R.A. won 4 games to 2.

SINGLE RACQUETS.

(Rubber of 5 Games.)

LIEUT. COOPER-KEY.	*v.*	CAPTAIN FRIEND.
12.	... ...	15.
15.	... ...	8.
15.	... ...	3.
15.	... ...	6.

R.A. won 3 games to 1.

DOUBLE BILLIARDS.

(300 up.)

MAJOR ANSTRUTHER. CAPTAIN MACMAHON.	*v.*	CAPTAIN DIGBY. CAPTAIN BADDELEY.
23.	... ...	50.
98.	... ...	101.
	101 all. 107 all. 117 all. 121 all.	
150.	... ...	126.
200.	... ...	156.
239.	... ...	200.
250.	... ...	215.
283.	... ...	250.
300.	... ...	274.

Order of play, and breaks of 10 and upwards:—

Captain Baddeley: 13, 14, 15, 13, 14, 19.
Captain MacMahon: 10, 31, 10.
Captain Digby: 10, 13, 10.
Major Anstruther: 20, 14, 10, 21, 11, 16.

(Time, 1 hour 45 minutes.)

SINGLE BILLIARDS.

(*500 up.*)

R.A.		R.E.
MAJOR ANSTRUTHER.	*v.*	CAPTAIN DIGBY.
50.	... ...	26.
74.	... ...	50.
100.	... ...	71.
144.	... ...	100.
152.	... ...	100.
200.	... ...	106.
212.	... ...	112.
250.	... ...	112.
300.	... ...	138.
310.	... ...	150.
376.	... ...	200.
400.	... ...	202.
450.	... ...	220.
500.	... ...	248.

Breaks of 10 and upwards:—

Major Anstruther: 10, 17, 10, 14, 14, 42, 36, 18, 14, 10, 13, 19, 24, 18, 12, 34, 15, 12.
Captain Digby: 13, 13, 17, 13, 13, 13, 10, 14, 15, 10, 13.

(*Time 2 hours 15 minutes.*)

The Regiment now holds both the Challenge Cups.

R.A. & R.E. Annual Racquet and Billiard Matches.

The results of the Racquet and Billiard Matches up to and including the present year are shewn below:—

1873.

Racquets.		*Billiards.*	
Double. R.A. 1.	R.E. 4.	*Double.* R.A. 500.	R.E. 497.
Lieut. W. E. Denison.	Lieut. L. K. Scott.	Lieut.-Col. Drayson.	Capt. Seton.
〃 W. L. Davidson.	〃 S. M. Haycock.	Major Maitland.	〃 Mant.
Single. R.A. 2.	R.E. 3.	*Single.* R.A. 500.	R.E. 361.
Lieut. W. L. Davidson.	Lieut. S. M. Maycock.	Major Maitland.	Capt. Mant.

1874.

Racquets.		*Billiards.*	
Double. R.A. 4.	R.E. 1.	*Double.* R.A. 500.	R.E. 492.
Major Newman.	Lieut. L. K. Scott.	Major Maitland.	Capt. Warburton.
Lieut. Crookenden.	〃 Tower.	Lieut. Anstruther.	〃 Seton.
Single. R.A. 0.	R.E. 3.	*Single.* R.A. 370.	R.E. 500.
Lieut. Crookenden.	Lieut. Tower.	Major Maitland.	Capt. Warburton.

1875.

Racquets.		*Billiards.*	
Double. R.A. 0.	R.E. 4.	*Double.* R.A. 500.	R.E. 494.
Capt. Anderson.	Lieut. Tower.	Capt. Hazlerigg.	Major Warburton.
Lieut. Crookenden.	〃 *Hon.* M. G. Talbot.	Lieut. Anstruther.	Capt. Skinner.
Single. R.A. 0.	R.E. 3.	*Single.* R.A. 286.	R.E. 500.
Capt. Anderson.	Lieut. Tower.	Lieut. Anstruther.	Major Warburton.

1876.

Racquets.		*Billiards.*	
Double. R.A. 3.	R.E. 4.	*Double.* R.A. 500.	R.E. 451.
Major Murdoch.	Lieut. Penrose.	Capt. Hutchinson.	Major Warburton.
Lieut. Anstruther.	〃 Onslow.	Lieut. Anstruther.	Capt. Skinner.
Single. R.A. 1.	R.E. 3.	*Single.* R.A. 479.	R.E. 500.
Major Murdock.	Lieut. Penrose.	Lieut. Anstruther.	Major Warburton.

1879.

Racquets.		*Billiards.*	
Double. R.A. 4.	R.E. 0.	*Double.* R.A. 500.	R.E. 430.
Capt. Griffiths.	Capt. L. K. Scott.	Major Hutchinson.	Major Seton.
Lieut. D. C. Carter.	Lieut. W. A. Cairnes.	Capt. Anstruther.	Capt. Glancy.
Single. R.A. 3.	R.E. 1.	*Single.* R.A. 500.	R.E. 421.
Lieut. D. C. Carter.	Lieut. W. A. Cairnes.	Capt Anstruther.	Capt. Glancy.

1880.

Racquets.		*Billiards.*	
Double. R.A. 4.	R.E. 0.	*Double.* R.A. 500.	R.E. 430.
Lieut. King.	Lieut. R. S. Hedley.	Major Hutchinson.	Major Manderson.
" Cooper-Key.	" W. A. Cairnes.	Capt. Anstruther.	Capt. Glancy.
Single. R.A. 0.	R.E. 3.	*Single.* R.A. 458.	R.E. 500.
Lieut. D. C. Carter.	Lieut. W. A. Cairnes.	Capt. Anstruther.	Major Manderson.

1881.

Racquets.		*Billiards.*	
Double. R.A. 4.	R.E. 0.	*Double.* R.A. 500.	R.E. 392.
Lieut. King.	Lieut. S. M. Maycock.	Major Hutchinson.	Capt. Glancy.
" Cooper-Key.	" W. A. Cairnes.	Capt. Anstruther.	" Broadfoot.
Single. R.A. 3.	R.E. 1.	*Single.* R.A. 500.	R.E. 468.
Lieut. Cooper-Key.	Lieut. W. A. Cairnes.	Capt. Anstruther.	Major Mant.

1882.

Racquets.		*Billiards.*	
Double. R.A. 4.	R.E. 2.	*Double.* R.A. 300.	R.E. 252.
Lieut. C. D. King.	Lieut. Tower.	Col. Maitland.	Major Seton.
" Cooper-Key.	" Friend.	Lieut. Bruen.	Major Glancy.
Single. R.A. 3.	R.E. 1.	*Single.* R.A. 500.	R.E. 437.
Lieut. Cooper-Key.	Lieut. Tower.	Col. Maitland.	Major Seton.

1883.

Racquets.		*Billiards.*	
Double. R.A. 1.	R.E. 4.	*Double.* R.A. 267.	R.E. 300.
Lieut. C. D. King.	Lieut. Tower.	Col. Maitland.	Lieut. Bor.
" Cooper-Key.	" Friend.	Capt. Anstruther.	Lieut. Dumbleton.
Single. R.A. 1.	R.E. 3.	*Single.* R.A. 500.	R.E. 297.
Lieut. C. D. King.	Lieut. Tower.	Capt. Anstruther.	Lieut. Dumbleton.

1884.

Racquets.		*Billiards.*	
Double. R.A. 3.	R.E. 4.	*Double.* R.A. 277.	R.E. 300.
Lieut. Cooper-key.	Lieut. Tower.	Lieut.-Col. Hazlerigg.	Lieut. Dumbleton.
" C. D. King.	" Friend.	Capt. Anstruther.	Capt. Digby.
Single. R.A. 2.	R.E. 3.	*Single.* R.A. 500.	R.E. 398.
Lieut. Cooper-Key.	Lieut. Tower.	Capt. Anstruther.	Lieut. Dumbleton.

1885.

Racquets.		*Billiards.*	
Double. R.A. 4.	R.E. 2.	*Double.* R.A. 300.	R.E. 274.
Lieut. Cooper-Key.	Capt. Friend.	Major Anstruther.	Capt. Digby.
" C. D. King.	Lieut. Hamilton.	Capt. MacMahon.	" Baddeley.
Single. R.A. 3.	R.E. 1.	*Single.* R.A. 500.	R.E. 248.
Lieut. Cooper-Key.	Capt. Friend.	Major Anstruther.	Capt. Digby.

This curious letter, in one of the notorious Cobbett's publications,[1] shows the backward position occupied by the Artillery at the beginning of the Century :—[*H.W.L.H.*]

Artillery Officers.

" Sir,

" In the numberless letters inserted in your Register, there has not been the slightest notice taken of the Ordnance. The Artillery, which forms so important a part of the interior strength of the empire, lies, I know not why, completely in the back ground, compared to the high estimation other countries hold theirs in. It surely ought to be a matter of regret, that an Artillery Officer in our Service, after devoting the early part of his life to the study of his profession, should, when he attains a perfect knowledge of it, be thrown aside. Yet, except in some very rare instances, the fact is strictly true. A young gentleman after receiving a classical education, is entered a Cadet at Woolwich Academy about the age of fourteen; before he receives his commission, he must go through a tedious and laborious course of Mathematics and Fortification; he must be thoroughly acquainted with the French language, with drawing, fencing, and every liberal art that adorns the gentleman, and forms the true Military character. With all these qualifications, and uniting a perfect knowledge of Infantry movements with his own professional skill, the Artillery Officer when he arrives to the rank of Second Colonel,—about thirty years' experience and service, —in nearly the prime of his age, and with all his faculties in full vigour, is thrown aside as useless, and incapable of further duty. The rank of Colonel of a Battalion is a decided death-blow to his Military hopes; and when, in other countries, Generals who have been brought up to the study of Artillery and Engineering, are preferred in consequence of their scientific skill; here, when that rank is obtained, it obliges the possessor to put on a brown coat, a round hat, and to sit down the remainder of his days as well as the disappointment of his dearest hopes will allow him.

I am,

Sir,

Yours, &c.,

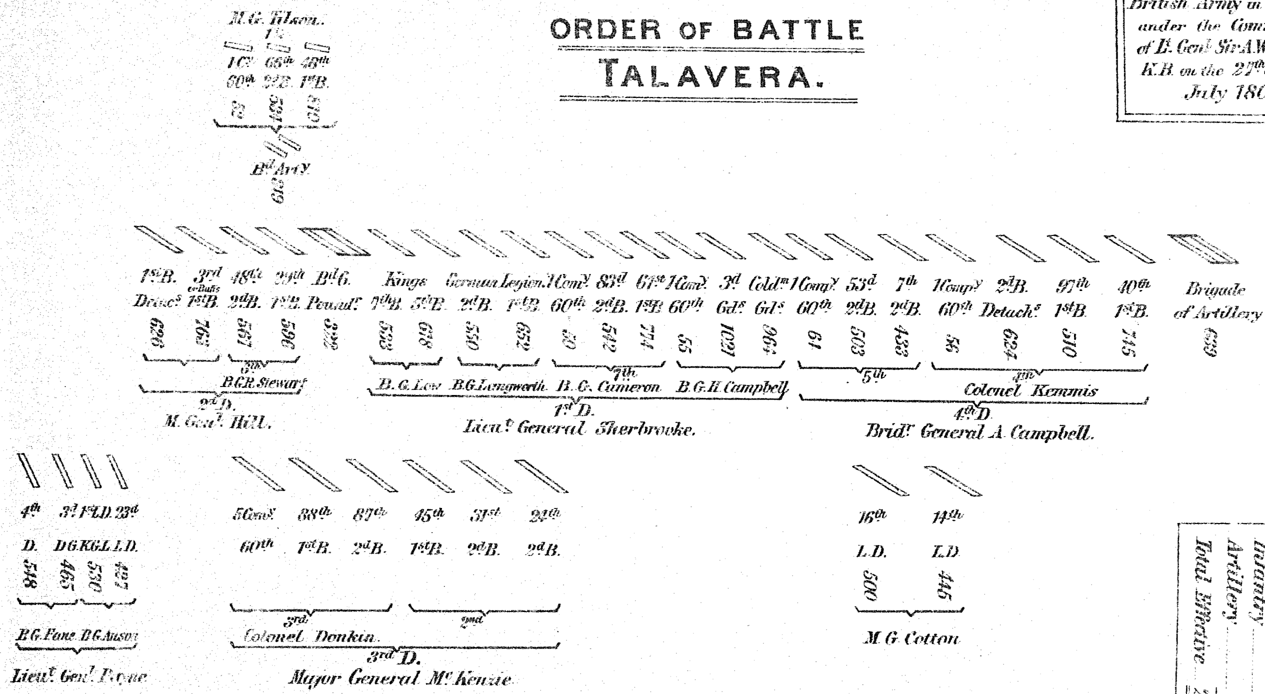
MILES."

---

[1] "Cobbett's Political Register." Vol. V., pp. 669, 670. May 5, 1804.

ORDER OF BATTLE
TALAVERA.

Order of Battle of the British Army in Spain under the Command of Lt. Genl. Sir A. Wellesley K.B. on the 27th & 28th July 1809.



Cavalry 2915
Infantry 16406
Artillery 1280
Total Effective 20601

From an Original made upon the spot, by Lieut. J. Hurford, 48th Regt. D.A.A.G. to Sir Arthur Wellesley.
Communicated by T. Hurford Esq., late Staff Vet. Surgeon.

FREDK DANGERFIELD LITH. LONDON 9631

MODERN SLIDE RULES.

BY

MAJOR H. S. S. WATKIN, R.A.

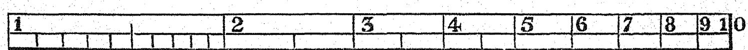
The application of Logarithms to a scale dates as far back as 1620, being the invention of Professor Gunter, and originally called "Gunter's Lines." Owing to the great facility at the present day of correctly dividing rules to any given dimensions by specially constructed machines, their accuracy and usefulness has been much increased. Gunter's Lines, which consists of Logarithm scales of numbers, sines, tangents, &c., may be seen on the ordinary sector supplied in the common pocket case of instruments. These scales are used with a pair of compasses, extending them forwards or backwards, according to whether multiplication or division is being performed.

The slide rule is a modification of the Gunter's Lines, the motion of the slide taking the place of a compass; so that the sums and differences of the logarithmic lengths may be seen at once.

A log scale may be constructed of any length, the longer the scale the wider apart are the sub-divisions, and the greater the accuracy of the calculation. It is usual to divide the length fixed upon into two portions, which are sub-divided and figured alike.

The following represents the half of a scale of Logarithms:—

Fig. 1.



The length from 1 to 10 being divided into 1000 equal parts, the length corresponding to the three first figures of the logarithms of 2, 3, &c., up to 9, as found in the common table of logarithms may be taken, and set off from the 1 at the commencement of the line for the Logarithms of 2, 3, &c., to 9. Sub-divisions as far as the length of the scale will admit, are obtained by setting off the logs of 1.1, 1.11, &c., &c.

In a similar manner, log scales of sines, tangents, &c., may be constructed. In multiplying two numbers together by such a scale, it is only necessary to add together the lengths on the scale corresponding

to these numbers, and note to what number the combined length extends. Thus, if with a slip of paper we add together the lengths from 1 to 2, and from 1 to 3, it will be found to extend from 1 to 6, showing that $2 \times 3 = 6$.

Division is performed by subtracting the lengths on the scale of one number from the length of the other. Thus, if we take a slip of paper of the length 1 to 6, and cut off from it the length from 1 to 2, the remainder will extend from 1 to 3, showing that $6 \div 2 = 3$. By combining the two processes such a sum as the following can be performed :—

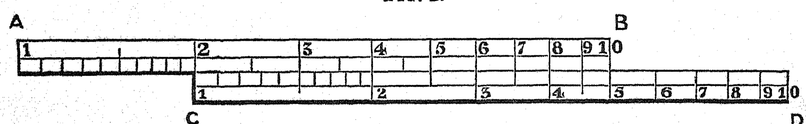
$$\frac{a \times b \times c, \text{ \&c.}}{d \times e \times f, \text{ \&c.}}$$

Similarly the square of a number may be obtained by doubling the length, and extending it on the scale; the cube by trebling it.

The square root is obtained by halving the length, the cube root by taking a third of the length corresponding to the numbers.

The slide rule consists of two (or more) scales, which slide against one another, thus enabling us to add or subtract any length of the scale with great convenience.

FIG. 2.



Thus, C D is a similar scale to that just described, sliding against the upper or fixed scale A B; and if, as in the figure, 1 on the lower scale is opposite 2 on the upper, we find that each of the figures on the lower scale has opposite to it figures corresponding to each multiplied by 2: thus 2 has 4 above it, 3 has 6, and so on. Had 1 been placed opposite 3, all the figures on the lower scale would have had above them figures corresponding to each multiplied by 3.

As the accuracy with which the computation can be made depends upon the length of the rule, various devices has been resorted to, to combine accuracy with portability: two of these we will briefly notice.

General Hannyngton cuts up the rule into convenient lengths, and places them one under the other, and thus a rule of considerable length can be obtained in a portable form. The effective length of one belonging to the Royal Artillery Institution is 120 inches; it has an eight-bar slide, and eleven bars on the board, the dimensions of which are 31×8 inches.

The following will give a general idea of the arrangement :—

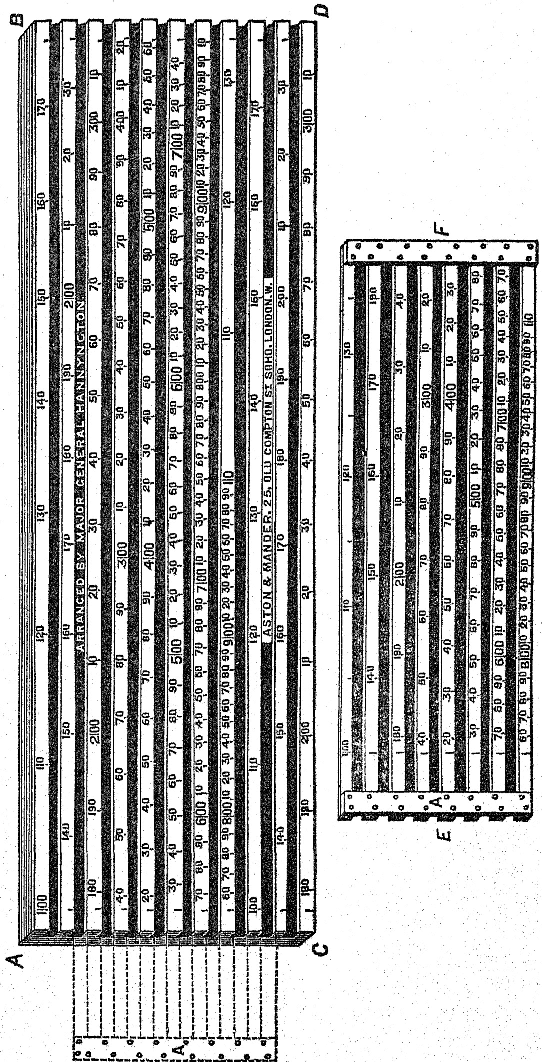
A, B, C, D, is the board with the eleven different bars; E, F, is the slide which fits into any of the spaces left on the board, so that any numbers on the slide can be placed opposite any number on the fixed scales. Thus multiplication, division, &c., can be performed as described on the following page.

These scales are exceedingly useful for comparing different measures. Thus, for instance, suppose we wish to convert metres to yards, place 292 on the slide opposite 267[1] on the fixed scale; the figures opposite to any number on the scale representing yards, will be its equivalent in metres. For instance, opposite 268·5 yards is found 245·5 metres,

FIG. 3.

EXTENDED SLIDE RULE,

ARRANGED BY MAJOR-GENERAL HANNYNGTON.



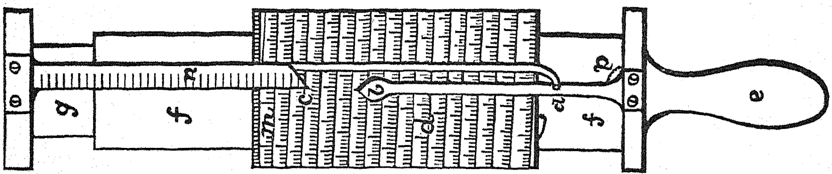
which is a close approximation, as by Col. Noble's tables it should be 245·512 metres. Any measures of which we knew any one equivalent can be immediately compared in this way.

Professor Fuller, of Queen's College, Belfast, has devised a rule which, though more portable than General Hannyngton's, being about

[1] 267 metres equals 292 yards.

1 foot 5 inches in length, and 4 inches diameter, has an effective length of scale of 41 feet 8 inches, giving an approximation of about $\frac{1}{10000}$ of the whole, which is sufficient for a great number of calculations.

FULLER'S SLIDE RULE.



Scale $\frac{1}{4}$.

The rule consists of a cylinder (d) that can be moved up and down upon, and turned round, an axis (f), which is held by a handle (e). Upon this cylinder is wound in a spiral a single logarithmic scale. Fixed to the handle is an index (b). Two other indices (c) and (a), whose distance apart is the axial length of the complete spiral, are fixed to the cylinder (g). This cylinder slides in (f) like a telescope tube, and thus enables the operator to place these indices in any required position relative to (d). (n) and (m) are two scales, the one on the piece carrying the moveable indices, the other on the cylinder (d).

The rule possesses some advantages over the old form besides that of increased length of scale. The setting and reading are performed by indices, and not by scale against scale. Also multiplications and divisions, containing a series of factors, can be worked with great facility; and as the logarithms of numbers, by the use of scales (m) and (n), are easily read, the powers and roots of numbers are within the capacity of the instrument. The following illustrates the method of using this rule:—The fixed index will be denoted by F. The top moveable index will be denoted by A. The lower moveable index will be denoted by B. When the indices are to be moved the term "set" is used. When the cylinder has to be moved the term "bring" is used.

MULTIPLICATION.

$$(a\times b)\begin{cases}\text{Bring }(a)\text{ to F.}\\ \text{Set A to 100.}\\ \text{Bring }(b)\text{ to A or B.}\\ \text{Product read at F.}\end{cases}$$

$$(a\times b\times c)\begin{cases}\text{Bring }(a)\text{ to F.}\\ \text{Set A to 100.}\\ \text{Bring }(b)\text{ to A or B.}\\ \text{Set A to 100.}\\ \text{Bring }(c)\text{ to A or B.}\\ \text{Product read at F.}\end{cases}$$

$$(a\times b\times c\times d)\begin{cases}\text{Bring }(a)\text{ to F.}\\ \text{Set A to 100.}\\ \text{Bring }(b)\text{ to A or B.}\\ \text{Set A to 100.}\\ \text{Bring }(c)\text{ to A or B.}\\ \text{Set A to 100.}\\ \text{Bring }(d)\text{ to A or B.}\\ \text{Product read at F.}\end{cases}$$

It will be seen that a similar sequence of operations applies to finding the product of any number of factors.

The above examples will show the general principles on which slide rules are worked, the pamphlets accompanying the rules gives detailed instructions for a variety of operations. There is no doubt, however, that experience is required in working these rules and getting accustomed to the reading of the graduations. When the nature of the calculations is always of one description, it facilitates the work to have a specially constructed rule.

Thus, suppose we want a scale to calculate the sides and angle of a right-angled triangle, as for range-finding from a battery, the sights of the gun, or any angle measuring instrument being employed to obtain the angle of depression.

A specially constructed scale, shown in the Plate, Fig. 4, would be the most convenient. The operations are so simple that any gunner can be taught its use in a few minutes. Suppose the height and angle of depression to an object be known; slide the centre scale out till the angle is opposite the height in feet, opposite the arrow on the lower scale will be found the range in yards; or, *vice versâ,* the distance and elevation of an object being known, its height can be obtained. With the aid of the rule a problem such as the following can be easily solved. Given the height of a gun above the water-level, the angle at which the axis is depressed, and a range-table for the gun, find the point at which the shot will hit the water. By cutting out the scales, and pasting them on a piece of cardboard, the centre scales can be applied to the others as required; or, better still, make a sliding scale of cardboard or wood, and glue the scales on to it, taking care that the top and bottom scales are fixed in the same relative position as shown in the figures. A more portable form of the rule is shown in the plate, Figs. 5, 6 and 7, where the scale is bent into a circular form.

To mount these scales, glue them in the first instance on to stout cardboard, cut a hole as shown at A in Fig. 6, and glue the piece cut out on the centre of Fig. 5. Place 6 over 5, which should revolve freely, to allow of the arrow being brought into any desired position. Now glue the raised surface of the circular piece A, Fig. 5, and secure Fig. 7 to it, so that 30 is opposite to 10 on the outer scale.

The method of using the scale is similar to that described for Fig. 4, the moveable circular scale of angles taking the place of the slide.

To obtain the height of an inaccessible object, take the angle to its apex, walk any convenient distance towards it, and again read the angle. Place the arrow at the distance walked in *yards;* multiply the angles obtained together and divide by their difference; opposite the number thus obtained on the centre scale, will be found the height in *feet* on the inner scale, thus—

If first angle read be 4°
If second angle read be 6°
Distance walked 30 yards,

$$\frac{6 \times 4}{6-4} = 12$$

Place the arrow at 30; when opposite 12° on the centre scale is found 19 on the inner, which is the height of the object in feet. Conversely the height being known the distance can be obtained.

EXPERIMENTS

WITH

10 AND 12-INCH ARMSTRONG GUNS AT CADIZ,

DECEMBER, 1884.

BY

MAJOR C. JONES, LATE R.A.

Having attended the experiments carried out in December last at Cadiz with two heavy guns supplied by Sir W. G. Armstrong, Mitchell, & Co., and mounted on the works of that city, I have drawn up the following brief account of the results obtained :—

These two guns are mounted in the Cortadura Fort, about two miles from the city on the narrow sand-spit that joins it with the mainland. The 10-inch gun fires in a southern and eastern direction, while the 12-inch gun can be fired in all directions, and thus not only covers the same space as the 10-inch, but can, in addition, bring its fire to bear in the defence of the harbour of Cadiz proper, and the approaches to the Arsenal of San Fernando.

The guns are mounted on Barbette Automatic Hydraulic Carriages and Platforms, the 10-inch (Plate I.) being on a front pivot, and the 12-inch (Plate II.) on a centre pivot. Each mounting is fitted with two recoil cylinders (or buffers) fastened to the bottom of the carriages, the two piston-rods being attached by links to the front and rear of the platforms. Thus the cylinders move while the pistons remain stationary during the recoil, and the strain on the piston-rods is tensional. The pistons are provided with valves, closed by powerful springs set to a definite resistance, and the energy of recoil is absorbed by the force required to further compress these springs so as to allow the oil (with which the cylinders are completely filled) to pass through the valves from the front to the rear of the pistons. There are small holes in the piston-head to allow the oil to pass back slowly as the gun runs out again automatically into the firing position.

As these guns were put in hand in September, 1882, they are not of the latest pattern, and are therefore not quite so powerful as guns now being made of about the same weight. They are both breech-loaders built up partly of steel, and partly of coils, on the Armstrong system, and are fitted with the Elswick pattern of obturator, consisting of an elastic steel cup carried on the face of the breech-screw. They are

vented in the axis of the breech-screw, with removable steel vent-bushes (or "needle-holders," as they are technically called), the vent-sealing primers being fired either by striking the needle by a hammer, actuated by an ordinary lanyard, or by electricity. In this latter case, the needle is removed, and the insulated wires from the primer are passed through the orifice in the "needle-holder."

The following are the principal dimensions, &c., of the guns:—

	10-inch Gun.	12-inch Gun.
Weight of gun in tons	26	43
Length in inches { Total	274·0	331·0
Length in inches { of bore	254·5	307·5
Length in inches { of chamber	49·0	51·0
Rifling—an increasing spiral	from 1 in 100 to 1 in 40 cals.	from 1 in 100 to 1 in 40 cals.
Weight in lbs. of { projectile	400	700
Weight in lbs. of { maximum charge of cocoa prismatic powder	200	310
Muzzle velocity in feet per second	2025	2000
Corresponding energy in ft.-tons { Total	11,374	19,415
Corresponding energy in ft.-tons { per inch of shot's circumference ...	364	517·7
Thickness of wrought-iron plate the gun can penetrate at the muzzle in inches	19·5	23·5

Experiments with 12-inch Gun.

The first object of the experiments was to test the mounting, the security of the pivot, and the firmness of the foundations, as well as the general working of the gun and carriage. With this object, the six rounds given in Table I. were fired.

The sixth round was fired at 17° elevation to test the mounting, the velocity could not therefore be observed.

After the first stiffness due to friction from hard paint, &c., had worn off, the carriage returned into the firing position each round automatically.

The breech mechanism worked with great facility, and the obturation was perfect; there was not the slightest sign of escape of gas either round the breech cup, or the vent-sealing primers used for firing the gun.

Two trial shots with chilled projectiles and 80 kilo. (176 lbs.) and 100 kilo. (220 lbs.) charges respectively were then fired to obtain the correct aim for firing at the armour target, and to determine approximately the charge necessary to give the striking velocity the projectile would have if fired at a range of about 2000 metres (2190 yards).

Three rounds were subsequently fired at the armour target shown on Plate III. with the results given in Table II.

TABLE I.

Round.	Weight of Charge.		Description of Powder.	Projectile. Weight.		Projectile. Description of Shell.	Muzzle Velocity.		Pressure on Chamber of Gun.		Recoil.	
	lbs.	kilos.		lbs.	kilos.		feet per sec.	metres per sec.	tons per sq. inch.	atmospheres.	inches.	mm.
1	220	100	Pebble	688	312·0	Common	1599	487·4	13·3	2030	31·4	798
2	290	132	Cocoa prismatic	696	315·7	Chilled	1894	577·3	14·4	2190	52·5	1334
3	319	145	Do	687	311·7	Do	2056	626·7	16·5	2510	59·5	1511
4	319	145	Do	693	314·3	Do	2056	626·7	16·6	2530	59·5	1511
5	319	145	Do	688	312·0	Do	2040	621·8	16·9	2575	64·5	1638
6	308·6	140	Do	688	312·0	Do	not observed	—	Not observed	—	56·0	1422

TABLE II.

Round.	Weight of Charge.		Weight of Chilled Projectile filled with sand.		Striking Velocity at 225 metres.		Recoil.		Range represented by Striking Velocity.		Penetration.
	lbs.	kilos.	lbs.	kilos.	feet per sec.	metres per sec.	inches.	mm.	yards.	metres.	
1	220·0	100	690	313·0	1575	480·0	41·5	1054	2950	2696	Through target and about 18 feet into sand butt.
2	220·0	100	695	315·25	1588	484·0	41·5	1054	2850	2605	Do.
3	154·3	70	689	312·5	1440	438·9	27·0	686	4080	3729	Through target and about 10 feet into sand butt.

The target (Plates III. IV. and V.) consisted of four thicknesses of plates 10^{cm} (3·94 inches) thick, backed by 25 inches of wood in two layers, the whole firmly supported by a foundation of wood, and wood balks as lean-to props bearing against piles driven into the sand. To prevent any movement of the target, and to stop the projectiles, a sand butt 10 metres (33 feet) thick was built up with sand-bags and wood boxes in rear of and touching the target.

The three shots were aimed at the three bull's-eyes marked on Plate III., and in each case the projectile struck exactly on the point aimed at, and obliterated the bull's-eye. The target was at a distance of 225 metres or 246 yards from the muzzle of the gun. The chilled projectiles fired the first and second rounds have been dug out of the sand butt entire, and unaltered in form, while the head of the third is entire for a length of about 12 inches, the body only being partly broken: this may have been due either to some unsteadiness from the low velocity, or from the giving way of the target, which fell over on to its face this round.

As these projectiles were chosen by chance from the supply furnished with the gun, the result is a proof of the excellence of the manufacture of the Elswick chilled projectiles.

The power of this gun can be judged when it has been shown by this experiment that it is capable of penetrating about 15 inches of iron (in four layers) backed by 25 inches of wood and an inner skin, at a range of over 4000 yards, and that the projectile had sufficient energy left to penetrate 10 feet into sand.

Experiments with 10-inch Gun.

As no opportunity had been allowed for testing the 10-inch gun mounting before sending it away from England, it was necessary to commence with some preliminary rounds with reduced charges, so as to regulate the pressure on the springs of the recoil-valves required to meet the maximum recoil.

It was also found to be impracticable to obtain reliable records of the velocity of the projectiles, as the breadth of the parapet in front of the muzzle was too small to allow of the velocity-screen being placed sufficiently far from the muzzle to be unaffected by the shock and the blast from the bore.

The results obtained at Ridsdale (Table III.), when the gun was proved will, however, give a fair indication of its power.

The rounds fired at Cadiz are given in Table IV.

After rounds 3 and 6, the springs of the recoil-valves were further compressed so as to reduce the recoil.

Round 7 was fired at 12° elevation, so as to increase the strain on the mounting.

The breech mechanism of the gun, and the whole mounting worked perfectly.

The recoil with the maximum charge of 200 lb. was a few inches within the full length allowed, and the gun returned gently into the firing position after each round.

TABLE III.

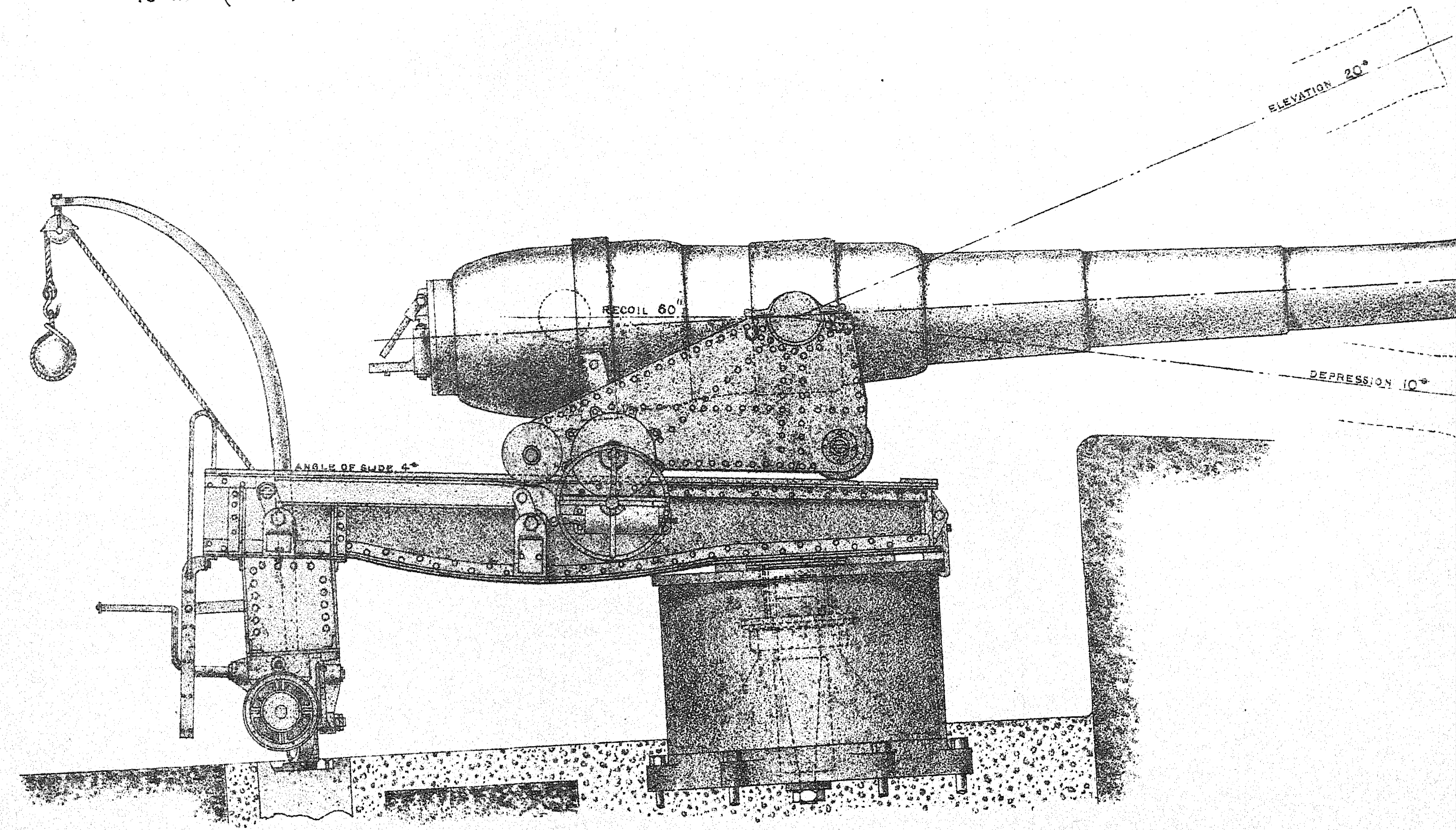
Round.	Weight of Charge.		Description of Powder.	Weight of Projectile.		Muzzle Velocity.		Pressure in Chamber.		Total Energy.	
	lbs.	kilos.		lbs.	kilos.	feet per sec.	metres per sec.	tons.	atmospheres.	foot-tons.	metre-tonnes.
1	180	81·65	One hole prismatic	501	227·2	1742	531·0	14·2	2160	10,542	3264·7
2	190	86·18	Do	505	229·1	1777	541·6	15·3	2330	11,057	3424·2
3	200	90·72	Do	504	228·6	1822	555·3	16·4	2500	11,601	3592·7
4	210	95·25	Cocoa prismatic	404	183·2	2086	635·8	14·9	2270	12,190	3775·1
5	210	95·25	Do	407	184·6	miss	—	14·8	2255	—	—
6	220	99·79	Do	403	182·8	2156	657·1	16·1	2450	12,989	4022·5

TABLE IV.

Round.	Weight of Charge.		Description of Powder.	Weight of Projectile.		Description of Projectile.	Pressure on Chamber.		Recoil.	
	lbs.	kilos.		lbs.	kilos.		tons.	atmospheres.	inches.	mm.
1	150	68	Pebble	399	181	Common Shell	15·2	2320	—	—
2	150	68	Do	396	179·5	Cast-iron do	14·7	2240	50·00	1270
3	165	75	Cocoa prismatic	397	180	Do do	10·2	1550	60·25	1530
4	180	81·5	Do	400	181·5	Chilled do	12·0	1830	—	—
5	180	81·5	Do	399	181	Do do	11·9	1810	—	—
6	180	81·5	Do	399	181	Do do	11·7	1780	63·00	1600
7	200	91	Do	399	181	Do do	15·0	2290	56·50	1435
8	200	91	Do	400	181·5	Do do	14·7	2240	59·50	1511
9	200	91	Do	404	183	Do do	14·7	2240	60·00	1524

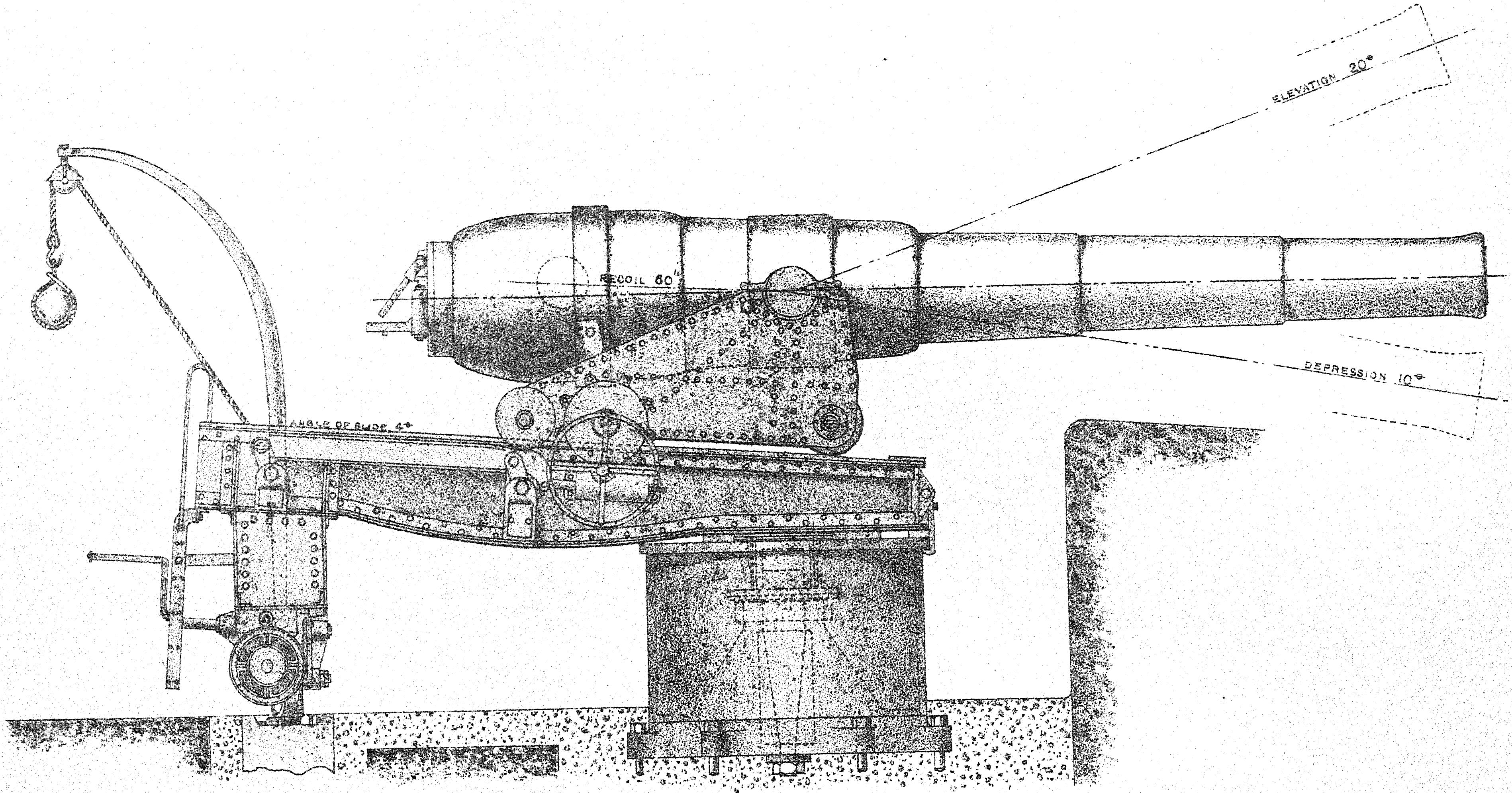
10 INCH (25 C/M) B. L. ARMSTRONG GUN ON AUTOMATIC GARRISON CARRIAGE AND PLATFORM (FRONT PIVOT.)

SCALE 1/40.



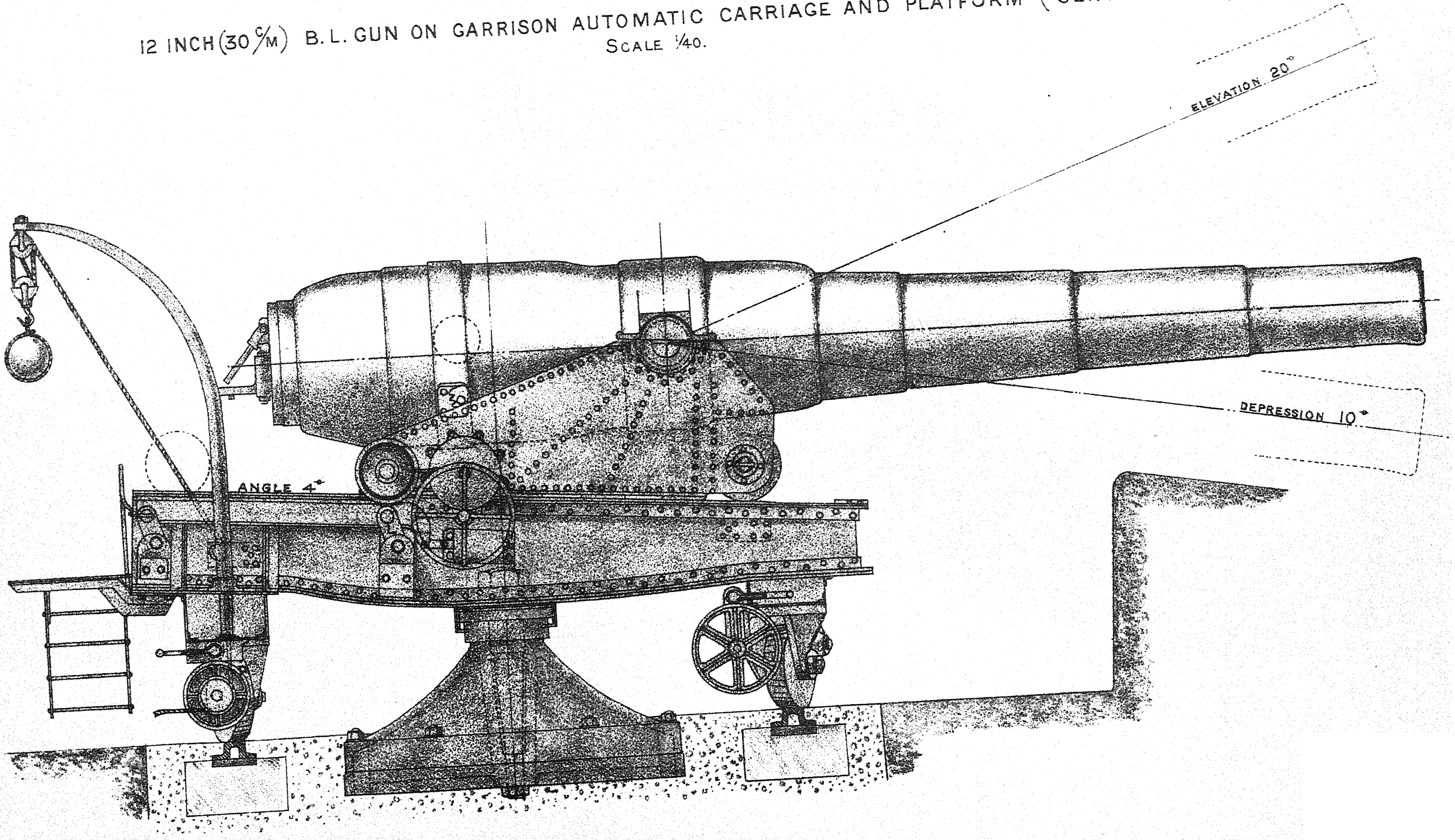
10 INCH (25 C/M) B. L. ARMSTRONG GUN ON AUTOMATIC GARRISON CARRIAGE AND PLATFORM (FRONT PIVOT.)

SCALE 1/40.



12 INCH (30 C/M) B. L. GUN ON GARRISON AUTOMATIC CARRIAGE AND PLATFORM (CENTRE PIVOT.)

SCALE 1/40.



Perspective View of Armour Target and Butt.

(From a Photograph by Colonel Noen, Royal Spanish Artillery.)

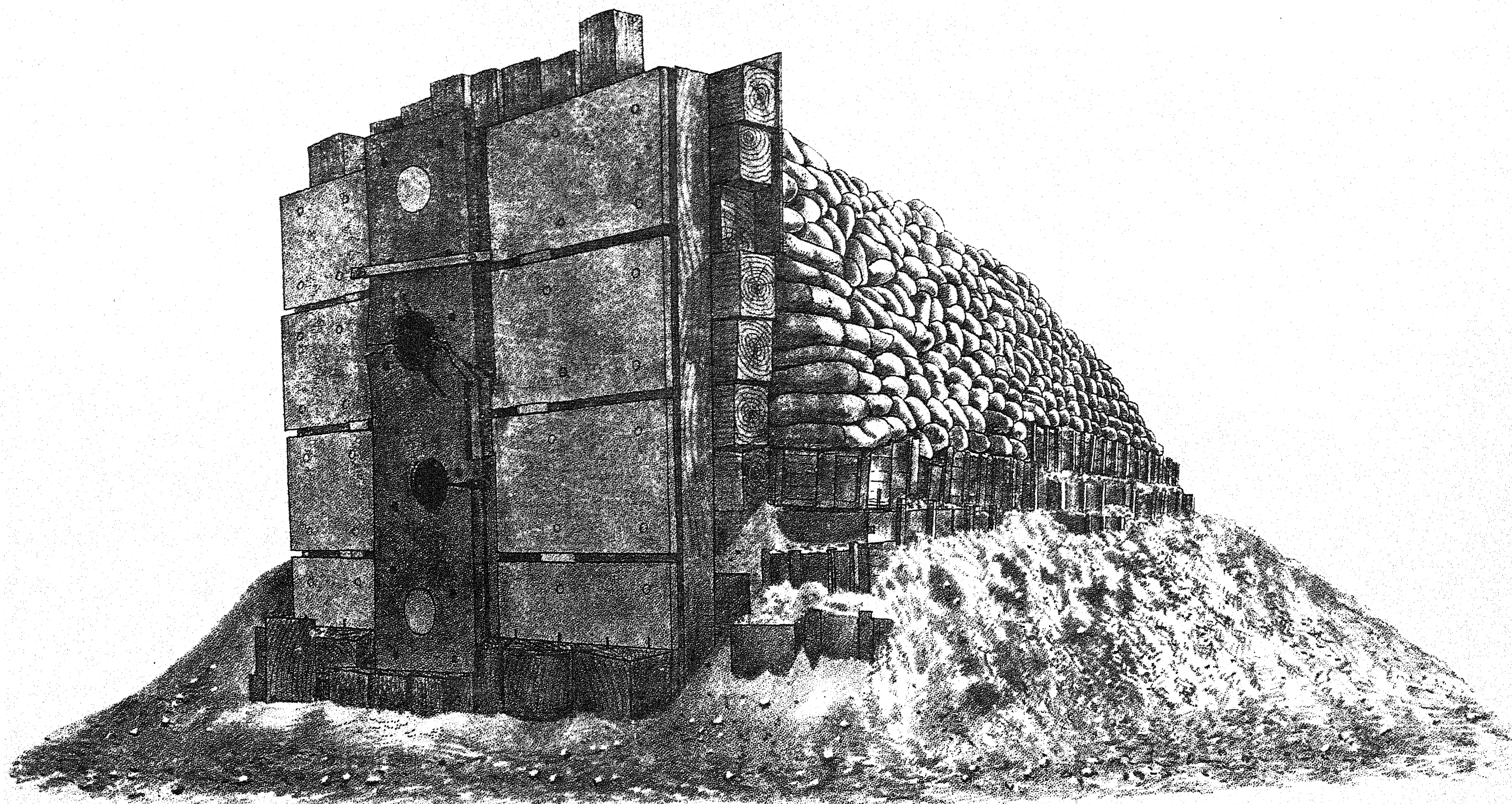
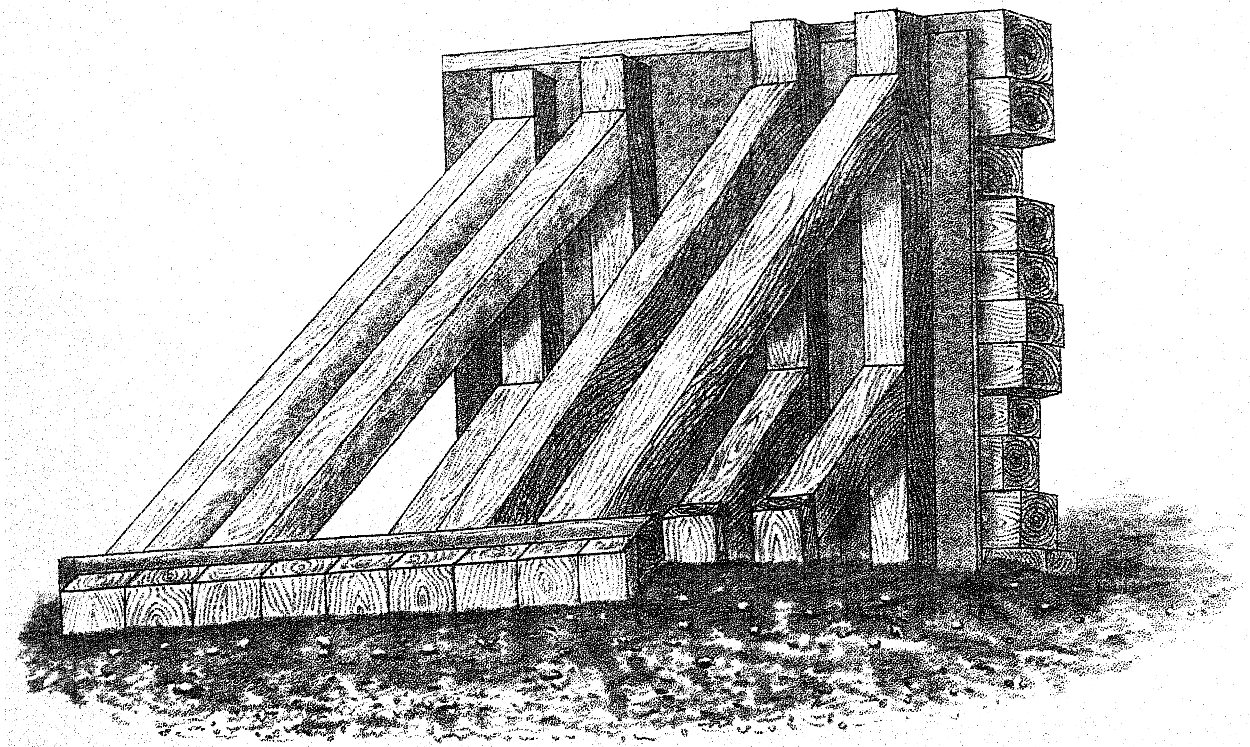


Plate IV.

REAR VIEW OF TARGET IN PERSPECTIVE BEFORE SAND BUTT WAS BUILT UP.

Fig. 2.



VERTICAL SECTION THRO. CENTRE OF TARGET.

Fig. 1.

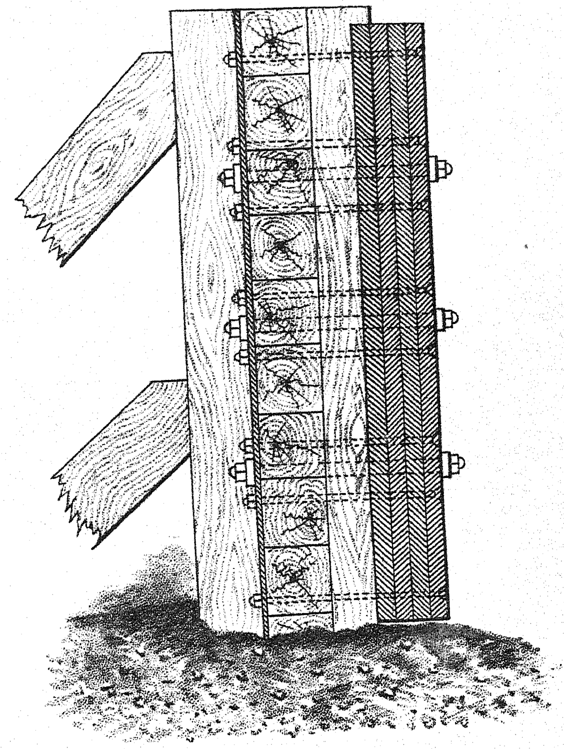
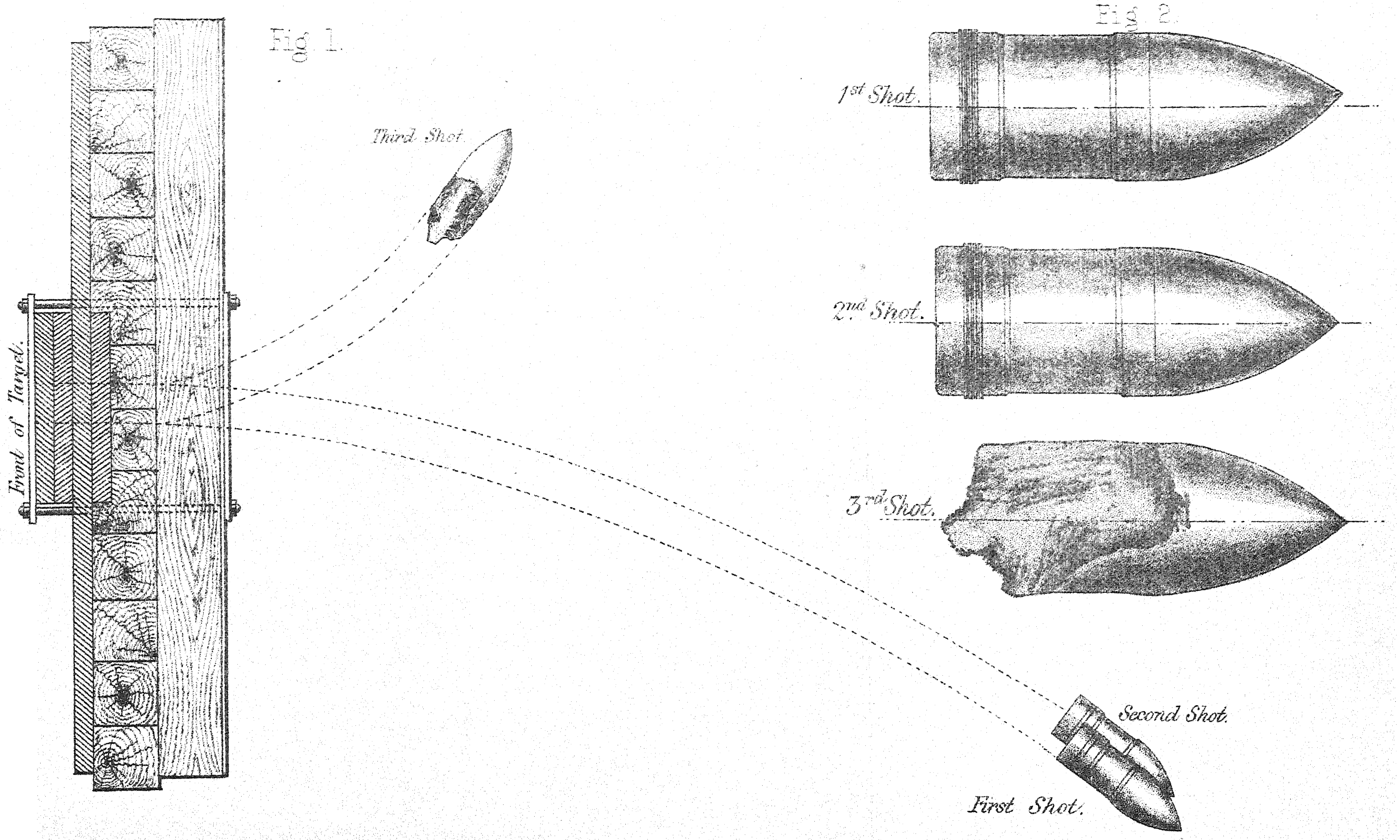


Plate V.

Plan of Target shewing position of Projectiles when recovered.

Scale 1/32.

Fig. 1.



Sketch of Projectiles when recovered.

Scale 1/2.

Fig. 2.

EXPERIMENTAL

DESTRUCTION OF HEAVY GUNS AT ALEXANDRIA,

UNDER THE PERSONAL SUPERINTENDENCE OF

CAPTAIN BEDFORD, R.N.

COMMUNICATED BY

MAJOR W. O. SMITH, R.A.

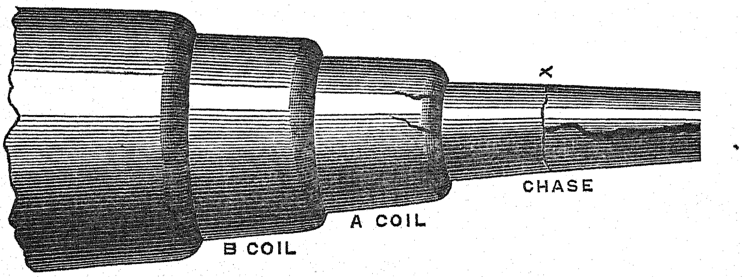
5TH FEBRUARY, 1885, AT FORT ADAH, ALEXANDRIA.

THE gun was a 10-inch M.L. Armstrong, weighing (as marked on trunnion) 40,026 lbs. It was placed in a pit, breech down, at about an angle of 70°. The pit was about eight feet diameter at the top and five at the bottom. The breech was partially buried in the sand, and the muzzle projected above the ground about one foot. The bottom of the bore was *apparently* filled up with sand to about the depth of about four feet; but after the second trial it was evident that the gun was loaded, and must have been so since the destruction of the Forts in 1882.

1st Trial.—The bore was filled with water, and two tin cases of "Naval Service Guncotton Primers" suspended in the water 4½ feet from the muzzle. Each tin contains 2¼ lbs. of guncotton—one tin being wet guncotton, the other dry. The detonator was exploded by electricity.

Result.—About 10 inches of the muzzle end of the steel tube was blown clean out, and found about 30 yards off. The next part of the tube was cracked into two or three pieces, and two large cracks ran down longitudinally from the then top of the tube for about two feet. The piece blown out was almost intact. The chase was cracked from the muzzle longitudinally for 3½ feet, when it met a horizontal crack (or rather separation of welds), which went nearly round the gun. The first crack was 2 inches broad. 'A' coil: there were two cracks half-an-inch broad and about 18 inches apart, extending longitudinally about 8 inches. The parts between these cracks had opened out.

Of course, the gun was totally disabled and could not have been loaded, much less fired again.



2nd Trial.—The bore was again filled with water as far as possible, which was to the crack marked 'X.' 18 lbs. of guncotton was used, being 8 tins, 6 wet guncotton and 2 dry. Four of these were placed as far on the bottom of the bore as they would go, and the other four about three feet above them.

Result.—The chase, as far as the crack marked 'X,' was blown clean away, and found about 12 yards off. 'A' coil was broken up into about eight or ten pieces. Trunnion-piece, breech, and tube inside the breech intact. After this trial a solid shot was found in two pieces, the base piece about 18 yards, and the point about 29 yards from the gun. The gun must, it was presumed, have been loaded, and I suppose that a small portion of powder in the centre of the cartridge must have been still dry enough to ignite and force the shell out. As the contractor wished the breech-piece to be broken into smaller pieces there was a third trial.

3rd Trial.—The remains of the tube in the breech was filled with water, and 9 lbs. of guncotton ($6\frac{3}{4}$ wet and $2\frac{1}{4}$ dry) placed at the bottom of the bore.

Result.—About a foot of the remaining part of the tube was blown out about 40 yards. The inside coils were all broken up, and the breech-piece cracked in two or three places.

7TH FEBRUARY, 1885, AT RAS-EL-TIN, ALEXANDRIA.

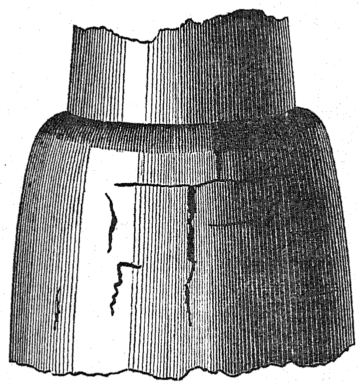
1st Experiment.

An Armstrong 10-inch, No. 2354 of 1870, weight 39,876 lbs., standing on iron carriage on an iron platform, elevated as far as possible.

1st Trial.—Filled with water and a charge of $4\frac{1}{2}$ lbs. guncotton in two canisters of $2\frac{1}{4}$ lbs. each, one being dry guncotton, the other wet. The charge was resting about the centre of 'A' coil.

Result.—The coils of the chase slightly parted in places. Steel tube

charge rested. Total length of largest crack about 9 inches, breadth about one-eighth of an inch, depth right through the coils. There was also a slight crack on the top of 'B' coil about 6 inches long. The gun and carriage recoiled on platform half-an-inch.

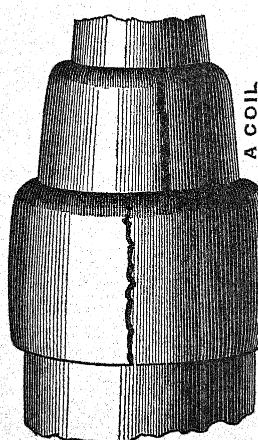


Appearance of 'A' coil underneath.

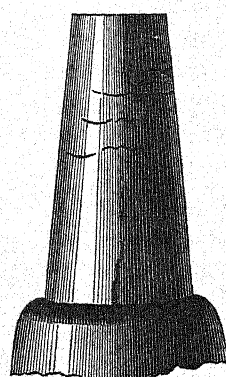
2nd Trial.—Gun filled with water, and a charge of 9 lbs. of guncotton placed in line with the trunnions, $6\frac{3}{4}$ lbs. wet guncotton and $2\frac{1}{4}$ lbs. dry.

Result.—The steel tube was badly cracked longitudinally, beginning about 3 feet from the muzzle, and running about 18 inches. 'A' coil was split right across, the split being quite half-an-inch broad. 'B' coil was also split right across, the breadth of split being slightly less. Both these were on the top of the gun. The chase was badly cracked on the right side running about 18 inches from 'A' coil. The welds of the chase coils were a good deal opened. The cracks in 'A' coil caused

TOP OF GUN.

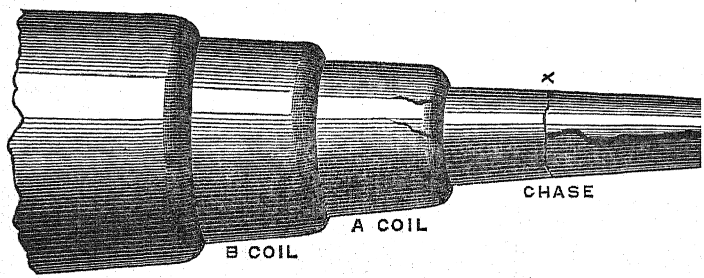


RIGHT SIDE OF CHASE.



by the first trial were unaltered. The gun was completely disabled; on being filled with water for the third trial the water *ran* out from the crack in A coil.

Of course, the gun was totally disabled and could not have been loaded, much less fired again.



2nd Trial.—The bore was again filled with water as far as possible, which was to the crack marked 'X.' 18 lbs. of guncotton was used, being 8 tins, 6 wet guncotton and 2 dry. Four of these were placed as far on the bottom of the bore as they would go, and the other four about three feet above them.

Result.—The chase, as far as the crack marked 'X,' was blown clean away, and found about 12 yards off. 'A' coil was broken up into about eight or ten pieces. Trunnion-piece, breech, and tube inside the breech intact. After this trial a solid shot was found in two pieces, the base piece about 18 yards, and the point about 29 yards from the gun. The gun must, it was presumed, have been loaded, and I suppose that a small portion of powder in the centre of the cartridge must have been still dry enough to ignite and force the shell out. As the contractor wished the breech-piece to be broken into smaller pieces there was a third trial.

3rd Trial.—The remains of the tube in the breech was filled with water, and 9 lbs. of guncotton ($6\frac{3}{4}$ wet and $2\frac{1}{4}$ dry) placed at the bottom of the bore.

Result.—About a foot of the remaining part of the tube was blown out about 40 yards. The inside coils were all broken up, and the breech-piece cracked in two or three places.

7th February, 1885, at Ras-el-Tin, Alexandria.

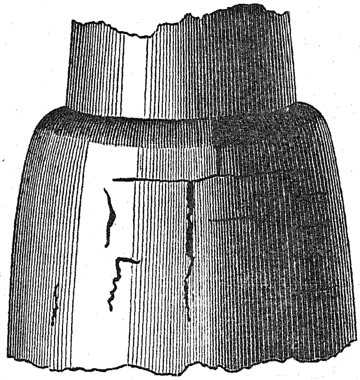
1st Experiment.

An Armstrong 10-inch, No. 2354 of 1870, weight 39,876 lbs., standing on iron carriage on an iron platform, elevated as far as possible.

1st Trial.—Filled with water and a charge of $4\frac{1}{2}$ lbs. guncotton in two canisters of $2\frac{1}{4}$ lbs. each, one being dry guncotton, the other wet. The charge was resting about the centre of 'A' coil.

Result.—The coils of the chase slightly parted in places. Steel tube apparently uninjured. 'A' coil opened and cracked just where the

charge rested. Total length of largest crack about 9 inches, breadth about one-eighth of an inch, depth right through the coils. There was also a slight crack on the top of 'B' coil about 6 inches long. The gun and carriage recoiled on platform half-an-inch.

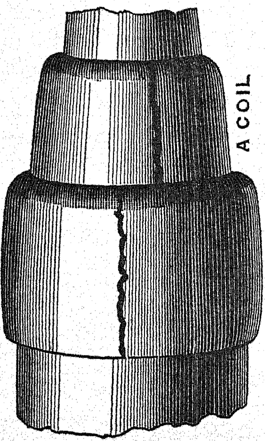


Appearance of 'A' coil underneath.

2nd Trial.—Gun filled with water, and a charge of 9 lbs. of guncotton placed in line with the trunnions, $6\frac{3}{4}$ lbs. wet guncotton and $2\frac{1}{4}$ lbs. dry.

Result.—The steel tube was badly cracked longitudinally, beginning about 3 feet from the muzzle, and running about 18 inches. 'A' coil was split right across, the split being quite half-an-inch broad. 'B' coil was also split right across, the breadth of split being slightly less. Both these were on the top of the gun. The chase was badly cracked on the right side running about 18 inches from 'A' coil. The welds of the chase coils were a good deal opened. The cracks in 'A' coil caused

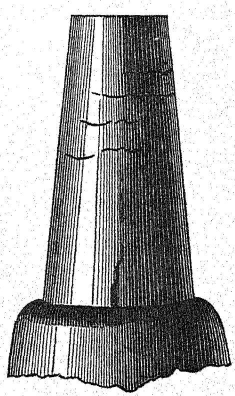
TOP OF GUN.



A COIL

B COIL

RIGHT SIDE OF CHASE.



by the first trial were unaltered. The gun was completely disabled; on being filled with water for the third trial the water *ran* out from the crack in A coil.

3rd Trial.—Two charges of 9 lbs. $2\frac{1}{2}$ feet apart; lower charge on bottom of bore. Three canisters of wet and one of dry in each charge. The bore filled with water as far as it would hold, viz., to and including 'B' coils.

Result.—The chase and 'A' coil with tube were blown away about 15 yards. The chase and 'A' coil were broken up, but all that part of steel tube was intact. 'B' coil was split and broken, merely hanging on to breech-piece by a small piece at bottom. The breech-piece was cracked the complete length, crack about half-an-inch broad. The recoil of the carriage was four feet.

2nd Experiment.

1st Trial.—This gun had been dismounted and sunk in a deep pit, the muzzle of the gun being about 10 feet below the level of the ground. The gun was a 9-inch Armstrong. After being filled with water, a charge of $22\frac{1}{2}$ lbs. of guncotton was placed as follows: 6 tins (each tin containing $2\frac{1}{4}$ lbs.) were placed at bottom of bore, 3 more 3 feet above them, and 1 more 2 feet above the latter.

Result.—The chase was cracked from the 'A' coil longitudinally for about two feet, the crack then turned across for about six inches; this crack was half-an-inch broad. The trunnion-ring was split, and there was a large crack a quarter-of-an-inch broad the whole length of the breech-piece. As the water came out of the crack in the chase when it was refilled the steel tube must have split somewhere, but where it was impossible to see or ascertain. The effect of this charge was much smaller than anticipated from the large size of the charge. Of course, the gun was quite unserviceable, but it was expected that it would have been broken up.

2nd Trial.—The gun was again filled with water as far as it would hold, namely, to about the joining of the chase and 'A' coil. The charge was the same as in No. 1, with the exception that there were only 3 tins instead of 6.

Result.—The breech and trunnion-pieces were blown to pieces, large pieces being completely detached, and the remainder all shattered. The chase and 'A' and 'B' coils did not appear to have suffered.

3rd Trial.—As the contractor wished, if possible, to have the muzzle part of the gun broken into smaller pieces, two tins were hung in the bore about the top of 'A' coil, there being, of course, no water.

Result.—The only result was the opening out of the crack made in the chase in the first trial.

11TH FEBRUARY, 1885, AT FORT SILSELEH.

1st Gun.—An Armstrong 9-inch, No. 1481, weight 27,468 lbs., resting with its muzzle on a low parapet about 3 feet high; breech

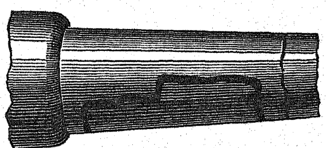
on ground, at an angle of 30°; filled with water. Charge, 2 tins wet guncotton, 1 tin dry guncotton (each tin weighing $2\frac{1}{4}$ lbs.), placed 5 feet 3 inches from the muzzle, which came to about the division of 'A' and 'B' coils.

Result.—The chase and 'A' coil were forced forward from the 'B' coil one inch, quite symmetrically. 'B' coil very badly cracked, and opened in three places longitudinally; one crack on the top being right through the next coil, and about an inch wide; could put a finger under 'B' coil between two of the cracks. This gun was loaded, and owing to water in the bore it was found impossible to blow the shell out. The shell was broken up by the explosion, and as it was a loaded one, this may have assisted in the destruction of the gun. Judging by the outward result, the tube (steel) must have been cracked; but this could not be proved as the muzzle was thrown off the parapet, and therefore not sufficient water could be put in afterwards to test this. The tube was, however, manifestly bulged, and practically the gun was quite unserviceable.

2nd Gun.—Another Armstrong 9-inch, No. 2710, of 1873; weight 27,695 lbs. This was in a pit, nearly vertical, and the muzzle projecting about two feet above ground.

1st Trial.—Two charges of $4\frac{1}{2}$ lbs.; one placed at bottom of bore, the other $3\frac{1}{2}$ feet above it. The bore being, of course, filled with water.

Result.—The chase was completely broken up, being split in numerous places, both round and longitudinally. The steel tube was also cracked in a similar way, one crack extending some four or five feet down, being half-an-inch wide. (On water being poured in again it came out in a stream just at the joining of the chase and 'A' coil.) The principal crack in the chase was two inches wide and nearly down to 'A' coil, where it turned round. 'A' and 'B' coils, and the breech, and trunnion-piece were unhurt.



Side view of chase.

2nd Trial.—Refilled with water as far as possible, viz., to top of 'A' coil. Charge, 3 tins were placed at the bottom, and 2 more $3\frac{1}{2}$ feet above them.

Result.—The muzzle (both chase and tube) was blown off for about 10 inches, just hanging on by a strip of chase coil. The 'A' and 'B' coils were again uninjured. The breech-piece was cracked the whole length longitudinally at both top and bottom, and another at the left

side nearly two inches wide. The top crack in the breech-piece went right through the coils underneath.

3rd Trial.—The gun was again filled with water, and held it as far as in the second round. A charge of 4 tins was placed about two feet from bottom of bore, just about the rear of trunnion-piece.

Result.—The only result was on the breech-piece; the piece between the top and side cracks of the last round being bulged right out. 'A' and 'B' coils still uninjured.

4th Trial.—The gun still held the water up to the same place as the two previous rounds. A charge of 4 tins was placed just below the trunnion-piece, and another of 3 tins just above the trunnion-piece.

Result.—The breech and trunnion-pieces were blown into pieces, which were lying all about the pit; the underneath coils were all split up, the end of the steel tube blown out, and the rest cracked. 'A' and 'B' coils were still intact.

ABSTRACT OF THE PROCEEDINGS

OF THE

FORTY-EIGHTH ANNUAL GENERAL MEETING

OF THE

ROYAL ARTILLERY INSTITUTION.

THE 48th Annual General Meeting was held in the Theatre of the Institution on Friday, 15th May, 1885, Maj.-Gen. H. A. Smyth, Commanding the Woolwich District, in the Chair.

I. The Notice convening the Meeting was taken as read.

II. The Abstract of the last Annual General Meeting was taken as read.

III. The Forty-eighth Annual Report, which was as follows, was read:—

1. The Committee beg to submit the 48th Annual Report of the Royal Artillery Institution.

2. There are now 1628 Members of the Institution, against 1603 last year. 76 Officers joined during the year, against 80 last year; while the deaths and withdrawals amounted to 41.—*See Appendix A.*

The number of deaths was 14, against 23 last year. Among them are to be noted those of the oldest Officer of the Regiment, General P. V. England, after 80 years' service; General Sir E. C. Warde, K.C.B.; Lieut.-General Selby (*late* Madras); Colonels W. W. Barry; H. J. F. E. Hickes; C. H. Barnes (*late* Bengal); Lieut.-Colonel E. H. Cameron. Three distinguished Artillerymen were killed in the deplorable explosion at Shoeburyness: Colonel Fox-Strangways; Colonel F. Lyon; and Captain F. M. Goold-Adams.

3. The accounts have been audited this year by Lieut.-Col. E. R. Wethered, and Major C. B. Piers, Staff Paymaster, R.A.

Appendix B shows that the financial condition of the Institution is satisfactory.

The cash which passed through the Secretary's hands amounted to £2681 3s. 2d., against £2667 9s. 4d. last year.

The General Credit, shown in the Capital Account, is £2659 8s. 5d., against £3149 12s. 9d. The Liabilities are £298 14s. 6d., most of which sum is owing to H.M. Stationery Office for books supplied to Officers, and is therefore recoverable.

Instead of showing, as usual, the amount in the Funds at full value, it has been thought better this year to show them at their market value. No money has been withdrawn.

The increase in the Expenditure is chiefly involved in two items, included under the heading of "Type, Materials, and Machinery." First, a new printing machine, worked by an Otto Gas Engine, was purchased during the year at an expenditure of about £360, the old machine having become quite worn out. Secondly, the present system of issuing the "Proceedings" and Regimental Lists monthly has naturally caused a very much increased consumption of paper.

It may be observed that the "Income," in Appendix C, is simply the *actual amount of money* received as Income during the year.

4. The Landscape Drawing Class has retained its popularity. Classes and individual Officers have been assisted by Institution funds at several out-stations for the study of foreign languages.

5. The Committee have continued the supply of Foreign Military Periodicals to Members willing to furnish from time to time, for publication with the "Proceedings," Reviews and Précis of their contents, as well as Translations in full of important articles.

6. The subject selected for the Prize Essay of the year was, "How far is the question of Massing Guns in the Field affected by Modern Improvements." Five Essays were submitted for competition.

Colonel C. Brackenbury, Lieut.-Colonel C. E. S. Scott, and Major and Lieut.-Colonel Yeatman-Biggs were good enough to act as Judges. The Committee, acting upon their Report, decided to award a Silver Medal to the Essay, Institution No. 5.

7. Sir Frederick Campbell, K.C.B., Lt.-Col. W. G. Brancker, C.B., and Major G. H. Marshall consented to act as Judges for the Rewards. In accordance with their Report, the Committee resolved to grant rewards to the writers of the following papers, whose names are given in alphabetical order:—

Callwell, Lieut. C. E. ...	"Tactics of our Small Wars" ...	£10
Johnson, Captain R. F. ...	"Le Mans Campaign"	£10
Lloyd, Lieut.-Col. F. T. ...	"Soudan Campaign"	£5
Mackinlay, Major G. ...	"Steel"	£5
Pratt, Major S. C.	"Egypt, 1801"	£5

8. The Committee have been unable to bring out the 2nd Part of the "Handbook for Field Service,"—Garrison and Siege; but hope to be able to do so in the course of the ensuing year.

APPENDIX C.

F THE STATE OF THE R.A. INSTITUTION

F TH *From 1838 to 1885.*

From

IV.	V.	VI.	VII.	VIII.
Expenditure.	Amount in the Funds.	Liabilities.	Cash Balance.	Percentage of Members on Active List to total strength of Regiment.
£	£	£	£	
272	—	—	343	—
119	—	—	194	—
171	120	—	117	—
143	150	—	101	—
111	300	—	116	—
165	500	—	203	—
104	500	—	—	—
136	500	—	—	—
978	500	—	—	—
742	500	—	—	—
368	500	—	212	96
695	500	—	182	82
647	1200	—	123	—
709	1200	—	54	83
733	1200	—	2	80
733	700	—	9	82
807	700	—	2	84
838	1200	—	100	55‡
1051	1200	249	26	59
996	1200	240	17	58
1028	1200	301	19	60
1088	1200	482	6	63
1040	1200	316	61	65
1167	1200	99	9	66
1011	1361	73	120	66
1273	1686	185	3	67
1153	1686	91	24	65
1118	1686	425	96	68
908	1686	232	433	76‖
1475	2000	111	271	78
1079	2000	385	512	78
1496	2000	100	344	80
1439	2000	145	243	82
1198	2000	105	412	83
1169	2000	91	632	83
1633	2300	162	395	81
1314	2300	229	546	85§
1369	2300	301	662	85
1446	2300	168	647	86
1721	2185	299	385	88

ıs.

r's income was subscribed for furnishing new building.

I have ap ımalgamated in this year.

d in this year from the strength of Regiment.

moved from the strength of the Regiment.

9. The Committee have resolved to publish the "Proceedings" monthly, as long as sufficient matter is obtainable.

10. The following changes in the Committee took place during the year:—

Lieut.-Col. W. H. Noble........	vice Lieut.-Col. R. Sandham.
" J. T. Leishman......	" Col. Nicolls.
Major G. W. C. Rothe	" Lieut.-Col. C. Thornhill.
Captain A. E. Russell...........	" Major R. S. Watson.
Lieut. H. S. Horne..............	" Lieut. P. H. Enthoven.
Major C. H. Hamilton	" Major E. H. Cameron.
Lieut.-Col. W. W. Murdoch ...	" Col. C. E. Nairne, C.B.

The Committee at present (1st April, 1885) is constituted as follows:—

PATRON AND PRESIDENT:

Field Marshal H.R.H. The DUKE OF CAMBRIDGE, K.G.

VICE-PRESIDENTS:

The Inspector-General of Artillery.
The Director of Artillery and Stores.
The Deputy-Adjutant-General, R.A.
The General Officer Commanding Woolwich District.

MEMBERS:

The Assistant-Adjutant-General, R.A.
The Director of Artillery Studies.
The Assistant-Adjutant-General, Woolwich.
The Secretary, Department of Director of Artillery and Stores.
General W. J. Smythe, F.R.S.
General Sir J. H. Lefroy, C.B., K.C.M.G., F.R.S.

Colonel E. Maitland.
" J. T. Leishman.
Lieut.-Col. W. H. Noble.
" T. J. C. A. Studdy.
" W. W. Murdoch.
Major G. W. C. Rothe.
" C. W. Long.
" G. H. Marshall.
Major S. C. Pratt.
" C. H. Hamilton.
" J. M. Alves.
Capt. C. Russell.
" J. R. J. Jocelyn.
" A. E. Russell.
" H. W. Morrieson.
Lieut. H. S. Horne.

Major H. W. L. Hime, *Secretary and Treasurer.*

Assistant Secretary.

Bankers:

Messrs. Cox & Co., and London & County Bank.

Solicitor:

E. W. Sampson, Esq., Woolwich.

TRUSTEES:

General St. J. St. George, K.C.B.
Sir C. Dickson, VC G.C.B.
D.-A.-G., R.A., for the time being.

IV. The Annual Report having been read to the Meeting, it was proposed and carried :—

"That the Annual Report, as read, be adopted."

V. The Secretary was requested to open the sealed envelope containing the name of the author of Essay, No. 5, to which a Silver Medal had been adjudged, provided it did not exceed the prescribed limit of length; and Major A. W. White was found to be the successful competitor.

VI. It was proposed that the subject for the Prize Essays for 1886, should be :—

"Having regard to the great improvements in Artillery *Matériel* during recent years, what should be the Organisation of the *Personnel?*"

This proposal was over-ruled by the Chairman, as involving a forbidden question.

It was then proposed and carried that the subject should be :—

"The Organisation and Practical Working of the Artillery Defence of a first class Coast Fortress, protecting a Harbour and Dockyard."[1]

(Signed) H. A. SMYTH,
Major-General,
Chairman.

APPENDIX D.

Presentations to the Library.

Report on the Circumstances attending an Explosion which occurred in a Cartridge Hut at the Factory of Nobel's Explosives Company (Limited), at Ardeer, Ayrshire, on the 8th May, 1884, by Colonel A. Ford, late R.A. ...	The Right Hon. the Sec. of State for Home Department.
Report on the Circumstances attending three Explosions, which occurred in Scotland Yard and St. James' Square, on the night of the 30th May, 1884, and an attempted Explosion in Trafalgar Square, at or about the same time, by Colonel V. D. Majendie, C.B.	
Report on the Circumstances attending an Explosion at a small Firework Factory at Wisbech on the 23rd June, 1884, by Major J. P. Cundill, R.A.	

[1] This proposal was submitted to H.R.H. Field Marshal, the Duke of Cambridge, Colonel of the Regiment, by the D.A.G., R.A., and was approved of, with the exception of the word "Organisation," for which the phrase, "General Management" was substituted.

Report on the Circumstances attending an Explosion which occurred on board a Steamer off Bournemouth, on the 20th August, 1884, by Colonel V. D. Majendie, C.B.	The Right Hon. the Sec. of State for Home Department.
Report on the Circumstances attending an Explosion of Gunpowder at a Gunpowder Factory at Blackburn, on the 26th July, 1884, by Colonel A. Ford, R.A.	
Report on the Circumstances attending an Explosion which occurred at the Worsborough Dale Gunpowder Factory on the 15th October, 1884, by Colonel A. Ford, late R.A.	
Report on the Circumstances attending an Explosion which occurred at Kingsbridge, County of Devon, on the 30th October, 1884, by Major J. P. Cundill, R.A.	
Report on the Circumstances attending an Explosion which occurred at Edenburn, County Kerry, on the morning of the 28th November, 1884, by Colonel A. Ford, late R.A.	
Report on the Circumstances attending an Explosion which occurred at Larne, on the 5th February, 1885, by Major J. P. Cundill, R.A.	
General Annual Return of the British Army for the year 1883	Secretary of State for War.
Army (Annual) Act, 1884.	
The Insurrection of the False Prophet.	
French Operations in Tong-King.	
Précis of Information concerning the Island of Labuan and the Adjacent Territories of the British North Borneo Company, with maps...	
W. O. Photographs. Nos. 6236–43, 6250–74, 6277–6398.	
Four-sheet Map of Tel-el-Kebir. Nos. 328–331	
Statement showing the variation of the numbers of Her Majesty's British Forces for the year 1885–6 and the amounts voted for 1884–5	
Statement showing the Amounts included in the Army Estimates 1885–86 for Military purposes in the Colonies and in Egypt, and the probable repayments by the several Colonies on the same account	
The Franco-German War, 1870–71. 2nd Part, 19th Section	
Lithographs: R.C.D., Nos. 72, 102, 141......	The Director of Artillery.
Lithographs: R.G.F., Nos. 71, 73, 75, 77, 79	
Lithographs: R.L., Nos. 150–160	
Range Tables for 6-inch B.L.; 4-inch B.L. of $13\frac{1}{2}$ cwt.; 12·5-inch R.M.L., Mark II.; 7-inch R.M.L. of 90 cwt.; 10-inch R.M.L.; 12·5-inch R.M.L. of 38 tons; 8-inch B.L., Mark I. and III.; 8-inch B.L., Mark II. and IV.; 80-pr. R.M.L.; 12·5-inch of 38 tons, Mark II. chambered; 10-inch R.M.L. gun	

with Mark II. gas checks; 5-inch B.L., Mark I. and II.	
Manual of Military Law. War Office, 1884...	
Tables of Weights and Measures for Batteries of Royal Horse Artillery—	
13-pr. R.M.L.	
9-pr. 〃 with Mark I. Carriage and Ammunition Wagon ...	
〃 〃 with Mark II. 〃 〃	
Tables of Weights and Measures for Batteries of Field Artillery—	
9-pr. R.M.L. with Mark I. Carriage and Ammunition Wagon ...	
〃 〃 with Mark II. 〃 〃	
16-pr. 〃 〃 I. 〃 〃	The Director of Artillery.
〃 〃 〃 II. 〃 〃	
13-pr. 〃 2 copies of each	
Extracts from the Proceedings of the Department of Director of Artillery, to date	
Handbook for the 12-inch R.M.L. Gun of 35 tons. Mark I. 1884. 2 copies	
Tables shewing comparative accuracy of various New Type Guns,: I. at long ranges; II. at medium ranges	
Handbook for the 9-pr. Hale's War Rocket Mule Equipment. Special for Egypt, 1885	
British Minor Expeditions from 1746–1814. 1 vol. London, 1884	
Accession to the War Office Library. No. 2. 1885	
Rules for the Conduct of the War Game. 1884. Official copy	
Syllabus of Course of Instruction for the Officers passing through the Artillery College. 1885. 2 copies	D.-A.-General, R.A.
Heavy Ordnance for National Defence, by Lieut. W. H. Jaques, U.S. Navy	Major G. Mackinlay, R.A
Report of the Gun Foundry Board, February 16th, 1884	
Minutes of Proceedings of the Institution of Civil Engineers, to date	
The Practical Application of Electricity. A Series of Lectures delivered at the Institution of Civil Engineers; Session 1882–3	The Council.
Proceedings of the Scientific Meetings of the Zoological Society of London, to date	The Council.
Catalogue of the Library of the Zoological Society of London	
Journal of the United Service Institution of India, to date	
Index to the twelve volumes of the Journal, issued during the period embraced by the years 1871 and 1883 inclusive, Nos. 1–58...	The Council.

Standing Orders for the Hydrabad Contingent Artillery. 1 vol. Bolarum, 1879…	Captain A. P. Penton, R.A.
Journal of the Royal United Service Institution	The Council.
The Royal Engineers' Journal (Monthly) ……	The Committee.
Map of the Egyptian Soudan ……	
Professional Papers of the Corps of Royal Engineers, to date ……	
Proceedings of the United States Naval Institute, to date ……	The Council.
Transactions of the Literary and Historical Society of Quebec: Sessions of 1863–1870 ……	The Council.
Do. do., Parts 1–3, Vol. 4 ……	
Do. do., Part 1, Vol. 5 ……	
The Archæological Journal, Nos. 161–164……	The Council.
Journal of the Military Service Institution of the United States, to date ……	The Council.
Catalogue of the Museum of the Military Service Institution of the United States ……	
The Journal of the Iron and Steel Institute, Nos. 1 and 2 1884 ……	The Council.
Proceedings of the Institution of Mechanical Engineers, 1884, and No. 1, 1885……	The Council.
Five Photographs showing the Operation of Landing Eight 12·5-inch Guns at Princes' Dock, Bombay ……	Colonel S. Penny, R.A.
Annual Report of the Board of Regents of the Smithsonian Institution, showing the Operations, Expenditure, and Condition of the Institution for the year 1882 ……	Smithsonian Institution.
Department of Militia and Defence of the Dominion of Canada. Annual Report, 31st December, 1884 ……	The Inspr.-General of Artillery, Canada.
Report of the British Naval and Military Operations in Egypt, 1882. Part I., text, and Part II., plates ……	The Director of Naval Ordnance, Washington.
Report on the Exhibits at the Crystal Palace Electrical Exhibition, 1882……	
Report of the Astronomer Royal to the Board of Visitors of the Royal Observatory, Greenwich, read at the Annual Visitation of the Royal Observatory, June 7, 1884 ……	The Astronomer Royal.
Results of the Magnetical and Meteorological Observations made at the Royal Observatory, Greenwich, in the year 1882 ……	
Report upon the Ninth Advanced Class of Artillery Officers, 1884 ……	Dir.-Gen. of Military Education.
Report of the Examination for Admission to the Staff College, held in June, 1884 ……	
Report of the Final Examination at the Staff College, held in December, 1884 ……	
Map of Simla and its Neighbourhood……	Lieut.-Col. W. H. Noble, R.A.
Photographs showing Experiments carried on at Shoeburyness by the Special Committee on Iron. 7 vols. ……	The Executors of the late General W. Henderson.

Notes on the Construction of Ordnance, to date Reports of the Chief of Ordnance to the Secretary of War for the years 1883–4 Ordnance Notes, Washington, U.S., to date Report of the Board on Testing Iron, Steel, and other Metals, Vols. 1 and 2, 1881 Report of the Gun Foundry Board, 1884 Report of the Tests of Metals and other Materials for Industrial Purposes Tests of Metals, &c., 1883	Brig.-General S. V. Benêt.
Collections of the New York Historical Society for the year 1875 Report of the Chapter of the Order of St. John of Jerusalem	Lieut.-Colonel F. Duncan, R.A.
Three Photographs showing the Operations of Mounting the 100-ton Gun at Rinella, Malta	Captain C. A. Ryan, R.A.
Specification of Patent, No. 4655, by Lieut.-Col. D. R. Cameron, C.M.G.	Lt.-Col. D. R. Cameron, C.M.G.
Report of the British Association for the Advancement of Science, 1883	Captain P. A. MacMahon, R.A.
Annual Report on the Instruction carried on at the School of Musketry, Hythe; and of the Progress of Musketry Instruction in the Army for the year ending 31st March, 1883	D.-A.-A.-General, Hythe.
Principles of Military Movements, chiefly applied to Infantry, by Colonel David Dundas, 1788 Rules and Regulations for the Formation, Field Exercise and Movements of His Majesty's Forces, 1793 Memoires Militaires sur les Grecs et les Romains. 2 vols., 1740 Rules and Regulations for the Field Exercise and Movements of the Army in Ireland, 1779. 2 copies	The late Brig.-Gen. A. H. Murray, R.A.
Canadian Militia Field Artillery Manual, 1884. 2nd Edition	Colonel D. T. Irwin, late R.A.
The late Battles in the Soudan, and Modern Tactics. A Reply	Lieut. C. B. Mayne, R.E.
British Soldiers for Service in India State Responsibility in regard to the Employment of Reserve Soldiers and their Transfer to Civil Life	Col. E. F. Chapman, C.B., RA.
Taktische Folgerungen-aus-dem Kriege, 1870-71 Im Lager der Franzosen Die Volkskrieg in Frankreich Die Operationen des Corps des General Von Werder Die Operationen der Sud-Armee in January and February, 1871 Die Operationen der Deutschen Heere, from Sedan to the end of the War German Official Account of the Franco-German War, 1870–71. Parts 1–20	Lt.-Col. W. G. Brancker, C.B.

Photographs of Maps dated 1652. 4 copies, viz., 1 each of Europe, Asia, Africa, and America	Captain W. Martin, late R.A.
Official Register of the Officers and Cadets of the U.S. Military Academy, West Point, New York, June, 1884	Governor U.S. Mil. Academy.
Course in Temporary Fortification, by James Chester, Captain 3rd U.S. Artillery .... Course in Permanent Fortification, by James Chester, Captain, 3rd U.S. Artillery ... . Course of Artillery, Part I., Section 4, Ballistics, by J. M. Ingalls, Captain 1st U.S. Artillery	Comdt. U.S. Artillery School.
Patents and Patentees, Vols. XIII. and XIV., for the years 1878–79	Governor of Victoria.
Report on the Egyptian Provinces of the Soudan, Red Sea, and Equator .... Report on the Principal Caravan Routes from Egypt and the Red Sea to Berber and Khartoum .... Sketch Map of the Nile, &c. No. 362 .... Map of Ambukol and Shendy. No. 367 ...... Map of the South-Western Frontier of the South African Republic . ... Map of the Nile Provinces from the Terminus at Suit to Berber .... Map of the Country between Suakim and Berber Map of Afghanistan. No. 431	A.-Q.-M.-General.
Examination Papers, R.M. Academy, December, 1884	Governor, R.M. Academy.
Plates A, B, and C, Ospedale Militaire Divisionaris	The Committee of Artillery and Engineers, Rome.
Address to the Geographical Section of the British Association, by General Sir J. H. Lefroy, C.B., K.C.M.G., F.R.S., LL.D. ... Extract from the Proceedings of the Victoria Institute Annual Meeting, 1884. Speech of General Sir J. H. Lefroy, C.B., K.C.M.G., F.R.S., LL.D.	The Author.
The Defence of New Zealand. An Address delivered by His Excellency Sir W. F. D. Jervois, G.C.M.G., C.B.........................	The Author.
Society for the Encouragement of Arts, Manufacture, and Commerce. Address delivered at the Opening of the 131st Session on November 10, 1884, by Sir F. A. Abel, D.C.L., C.B., F.R.S. .... Final Report on Experiments bearing upon the Question of the Condition in which Carbon exists in Steel, by Sir F. A. Abel, D.C.L., C.B., F.R.S. .... Accidental Explosions produced by Non-explosive Liquids, by Sir F. A. Abel, D.C.L., C.B., F.R.S.	The Author.
Handbook of Artillery Matériel, by F. C. Morgan, Major, R.A.	The Author.

The Army and the Public: An Appeal to the Patriotic, by Captain C. W. White..	The Author.
Our Military Position: A Note of Warning, by Captain C. W. White	
Ambulance Organization, Equipment and Transport, by Surgeon-Major G. J. H. Evatt, M.D., A.M.D.	The Author.
Institution of Mechanical Engineers. On the History of Paddle-wheel Steam Navigation, by Mr. Henry Sandham. 2 copies	The Author.
Fors Clavigera Letters the 95th and 96th. By J. Ruskin, LL.D.	The Author.
Course in Artillery, Exterior Ballistics by J. M. Ingalls, Captain 1st U.S. Artillery	The Author.
Machine Guns. The Gatling Gun: its positive feed, high-angle fire, and use in war, by Dr. R. J. Gatling	The Author.
Plates Nos. 145–47, and 149–57, Netherlands Artillery Atlas..............................	Netherlands Legation.
Revista Militär Española, to date	Spanish Government.
Russian Artillery Journal, to date	Russian Government.
Revista Marittima, to date	Italian Government.
The Ratnik, to date	Servian Government.
Relazioni Intornio, to date	
Artillery Tidskrift, to date	Swedish Government.

APPENDIX E.

Books, &c., Purchased.

Biologia Centrali-Americana.
Zoology. Parts 30–37.
Botany. Part 18.
Gould's Birds of New Guinea. Part 19.
Jahresberichte über die Veränderungen und Fortschritte im Militarwesen. Berlin, 1883–84.
Regulations relating to the issue of Army Allowances. 1884.
Carnet de L'Officer de Marine. 1884.
Internationale Revue über die Gesammten Armeen und Flotten.
From "Coruña to Sebastopol." The History of 'C' Battery, 'A' Brigade, R.H.A., by Colonel F. A. Whinyates, late R.H.A.
R.E. Aide Memoire. Part 2. 1883.
Gunnery Drill Book for H.M. Fleet. 1882.
The Encyclopædia Britannica. Nos. 17 and 18. 9th Edition.
The Ibis: a Quarterly Journal of Ornithology, to date.
Vorlesungen über Zahlentheroie, to date.
Kriegsgeschichtliche Einzelschriften, to date.
English and Swedish Dictionary. 2 Vols.

A practical grammar of the Swedish Language. 1 Vol.
Memoir of Lieut.-General Albert Borgard. By Captain O. R. Olsen.
A Treatise on the Application of wire to the construction of Ordnance. By J. A. Longridge. 1 Vol. London, 1884.
Hindustani-English and English-Hindustani Dictionary. By Dr. Forbes.
Bāgh o Bahār. By Dr. Forbes, LL.D.
Théorie des Formes Binaires. 1 Vol. Turin, 1876.
Military Dandies or Heroes of 1818. Coloured print.
La General Comte Todleben. Par Le Lieut.-General A. Brialmont.
The Physical Geology and Geography of Great Britain. By A. C. Ramsay, LL.D., F.R.S., &c.
A grammar of the Hindustani Language in the Oriental and Roman character. By Dr. Forbes, LL.D.
The Sieges of Vienna by the Turks. By the Earl of Ellesmere. 1 Vol.
A grammar of the Danish and Norwegian Languages. By H. Lund.
A grammar of the Swedish Language. By C. Lénström
La Machine Animale. Par E. J. Marey.
A General Dictionary of Geography. By Keith Johnstone, F.R.S.E.
Army Regulations. Vol. 8.
Analyses of the Rules for reckoning Soldiers' Service towards Limited Engagement, Pension, and G. C. Pay. By Colonel H. P. Montgomery, Rifle depôt.
Lectures on Staff Duties. By Major F. C. H. Clarke, C.M.G.
Corso di Balistica. 3 Vols. and Atlas.
Principles of the Manufacture of Iron and Steel. By I. Lowther Bell, F.R.S.
Formule Pratique des Télémetrés. Par P. Peigne.
Carnet de Poche a L'Usage des Officiers D'Artillerie. Par H. Plessix. Paris, 1884.
The Art of War in the Middle Ages, A.D. 378–1515. By C. W. C. Oman, B.A. 1 Vol. London, 1885.
Phillips' Map of Manitoba. 2 sheet.
A Treatise on the Higher Plane Curves. By G. Salmon, D.D., &c.
Preliminary Annual Return of the British Army, for the year 1884.

APPENDIX F.

Presentations to the Museum.

Fetters from the Prison at Tokar Sheep Shearing Scissors from Tokar Soudanese Water Bottle " Pillow or Head Rest Bottle for grease with which the Soudanese anoint their Heads	Lt.-Col. F. T. Lloyd, R.A.
A sample of Gunpowder which has been Fired from Heavy Ordnance	The late Lt.-Col. E. H. Cameron, h.p., R.A.
3 Metal Egyptian Time Fuzes 1 Wood Time Fuze 2 Friction Tubes Parts of Fuze taken out of a Common shell at Tel-el-Kebir	Capt. H. C. M. Woods, R.A.

2 pieces of Sand Stone Rock taken from the vertical Cliffs of Mount Roraima, British Guiana. Elevation 7759 feet .... 12 Birds from the Roraima Mountains, British Guiana	H. Whitely, Esq., Junr., C.M.Z.S.
Old Norwegian Powder Horn of the 17th Century from the Saltersdal, Christianaland........... Hanoverian Waterloo Medal	Capt. J. C. Dalton, R.A.
6 Silver Coins, viz: German, 2; Austrian, 2; Belgium, 1; Egyptian, 1	Major H. W. L. Hime, R.A.
2 Egyptian Mummies, viz.; 1 of an Infant, 1 of an Ibis, brought from Egypt in 1802, by General The Earl of Cavan	Capt. E. A. Lambart, R.A.
Regulation Head Dress worn by Paymasters of the R.A., prior to 1860	Major C. B. Piers, R.A.
11 Ancient Indian Coins from Delhi	Lt.-Col. H. G. Young, late R.A.
2 Drum Banners formerly belonging to the R.H.A. Band	The R.A. Band Committee.
8 Hindoo Idols	The Executors of the late Capt. J. N. P. Dadson, late R.A.

APPENDIX G.

List of Papers published in the "Proceedings" during the Year.

Heavy Gun Practice. By Major D. D. T. O'Callaghan, R.A.

Rifles for Large Game. The Trajectories, Time of Flight, Remaining Velocities, and Striking Energies of Bullets fired from Large Bore and Express Rifles. By Major W. McClintock, R.A., Assistant Superintendent, Royal Small Arms Factory, Enfield.

Notes on Interior Economy of Native Mountain Batteries. By Captain J. D. Douglas, R.A., Commandant No. 1 (Bombay) Mountain Battery.

Military Rifles. Communicated by the Director of Artillery.

Battle Fields in the Le Mans Campaign. Nos. 1–11. By Captain R. F. Johnson, R.A.

The Manufacture of Steel, and its Application to Military Purposes. A Lecture delivered at the R.A. Institution on 6th March, 1884. By Captain G. Mackinlay, R.A.

Note on the Supply of Ammunition to Guns in a Fort, and Suggestion for Simplification of Drill. By Captain E. Nash, R.A.

A Short Report of the Landing of Eight 12·5-inch Guns at Princes Dock, Bombay. By Lieut.-Col. S. Penny, R.A.

Brief Sketch of the Gunpowder Works in the Presidency of Bengal. By Major-General F. W. Stubbs, R.A.

Abstract of the Proceedings of the Forty-seventh Annual General Meeting of the Royal Artillery Institution.

Report of the Operations of the Royal Artillery in the Soudan, in February and March, 1884. By Brevet-Lieut.-Col. F. T. Lloyd, R.A.

From Coruña to Sevastopol. The History of C Battery, A Brigade, R.H.A. By Colonel F. A. Whinyates, late R.H.A. A Review. By Major H. W. L. Hime, R.A.

Calculation of Trajectories in direct and Curved Fire. By A. G. Greenhill, M.A., Professor of Mathematics to the Advanced Class of Artillery Officers.

Notes on the Purchasing, Distribution, and Care of Royal Artillery Remounts. By Colonel F. G. Ravenhill, R.A., Inspector and Purchaser of R.A. Horses.

The Egyptian Campaign in 1801. By Major S. C. Pratt, R.A.
Method of Carrying a Clerk's Platform. By Lieut. M. S. C. Campbell, R.A.
General Gordon on the Employment of Artillery in Irregular Warfare. Communicated by Colonel W. H. Goodenough, R.A.
Battle of Albuera. From an old MS. by the late Lieut. W. Unger, G.A.
Remarks on the War Services of Lieut.-General Albert Borgard. By Major H. W. L. Hime, R.A.
A Flying Visit to the Crimea. By Captain F. Beaufort, R.A.
Précis of Experiments at Dungeness and Lydd, 1880–81. By Lieut.-Col. F. G. Baylay, R.A.
Practical Rule for Range-Finding. By Captain P. A. MacMahon, R.A.
On Keeping Battery Horses in Condition. By Major T. B. Tyler, R.H.A.
Account of a Visit to the Spanish Gun and Small-Arms Factories at Trubia and Ovieda, in May, 1884: with a Description of the New Ordoñez R.B.L. Gun of 15^{cm}, together with a Table comparing the Properties of the latter with those of corresponding Guns in the British Service. By Captain J. C. Dalton, R.A., D.-A.-A. and Q.-M.-G., Gibraltar.
Remarks on Revolvers. By Major W. McClintock, R.A., Assistant Superintendent Royal Small-Arms Factory, Enfield Lock.
A Distinguished Gunner. By Captain R. H. Murdoch, R.A., Assistant Superintendent R.A. Records.
A French Method of Estimating Distances. From *La Nature.*
Simple Telescope Sight for Field Guns. By Lieut. H. A. Bethell, R.A.
Experiments in Bursting of Heavy Guns with Guncotton. By Lieut. F. A. Randolph, R.A.
Velocimeter with Tuning-fork and Electric Registers. Reprinted from "U.S. Ordnance Notes," No. 313. Communicated by Major W. B. Hemans, R.A.
The Services of the late General P. V. England, R.A. By Major H. W. L. Hime, R.A., Secretary, R.A. Institution.
A Brief Description of Old Fougasses dug in the solid rock along the Coast of Malta. By Lieut. A. Samut, R.M.F.A.
Recent Gunnery. By Major G. Mackinlay, R.A.
Horse Sickness (or Anthrax) in South Africa: its Nature, Causes, Prevention, Symptoms, and Treatment. By James Lambert, Esq., F.R.C.V.S., Inspecting Veterinary Surgeon, Army Veterinary Department. Reprinted from the Natal Government Gazette. Communicated by the Secretary.
The Range-Reader. By Lieut.-Colonel P. Nolan, *late* R.A.
Handkook of Artillery Matériel: by Captain F. C. Morgan, R.A. A Review. By Major G. Mackinlay, R.A.
Notes on Entraining Artillery. By Captain E. S. May, R.A.
A Russian View of the Battle of Inkerman. By Captain F. Beaufort, R A.
The Establishment of Steel Gun Factories in the United States: by Lieut. W. H. Jaques, U.S.N. A Review. By Major G. Mackinlay, R.A.
Sketch of Drill and Exercise for Two Batteries of Horse Artillery and Two Regiments of Cavalry. By Colonel W. J. Williams, R.H.A., C.B.
A Few Remarks on Fortification. By Lieut. C. E. Callwell, R.A.
Description of an Experimental Hydraulic Field Carriage for the 12-pr. B.L. Gun. By Captain W. J. Clarke, R.A.
Memoranda relating to the Sortie, Gibraltar, 27 November, 1781. Communicated by the Secretary.
Notes on the Duties of Newly-Appointed Adjutants. By Major J. C. Gillespie, R.A.
A Short Account of some Practice at Moving Objects, in the Western Forts District, Isle of Wight. By Lieut.-Colonel E. Lyons, R.A.
Short Description of Shwartzopf's Wrench. By Captain E. H. Walker, R.A.

APPENDIX H.

Précis and Translations published during the year.

FRANCE...

"Revue d'Artillerie." October, 1883. By Capt. H. H. Costobadie, R.A.
Practice from Coast Batteries.

"Revue d'Artillerie." January and February, 1884. By Capt. A. H. C. Phillpotts, R.A.
The German Artillery in Peace Time.

"Spectateur." By Major H. H. Costobadie, R.A.
"*La Nation Armée.*"

"Regulations of Austrian Artillery." By Major H. H. Costobadie, R.A.
Practical Instruction in Siege and Fortress Artillery.

"Revue Militaire de l'Etranger." 15th February, 1884. By Major J. H. G. Browne, R.A.
Combat of the Division in Italy.

"Revue d'Artillerie." By Capt. A. H. C. Phillpotts, R.H.A.
Instruction in Shooting for Field Artillery.

"Revue Militaire de l'Etranger." 15th July, 1884. By Major J. H. G. Browne, R.A.
The Russian School of Gunnery.

GERMANY

"Organ, &c." By Lieut. J. M. Grierson, R.A.
Russian Manœuvres at Warsaw in 1882.
Drill, or Military Education?
Miscellaneous Notes.

"Archiv." By Lieut. J. M. Grierson, R.A.
A Generalization of Sebert's Method of Registering the Velocity of a Projectile in the Bore of a Gun.

"Extracts from German Newspapers." By Lieut.-Colonel G. T. Pretyman, R.A.

ITALY......

"Giornale di Artiglieria e Genio." May, October, and December, 1883. By Capt. E. B. Evans, R.A.
A Fuze with Two-fold Action, and an Universal Projectile for Field Artillery.
Provisional Establishment of Two Brigades of Horse Artillery.

RUSSIA ...

"The Russian Artillery Journal." February, 1884. By Lieut. J. M. Grierson, R.A.
Remarks on Watkin's Range-Finder.
Arming Batteries in a Fortress, and firing by night.

"Vojenni Sbornik." By Lieut. V. F. W. A. Paget, R.H.A.
Six or Eight-gun Batteries.?

SPAIN......

"Revista Cientifico-Militar." July, 1884. By Capt. J. C. Dalton, R.A., D.-A.-A.-G. and Q.-M.-G., Gibraltar.
The New Prismatic Powder adopted by Spain.

SWEDEN

"Artilleri-Tidskrift." Nos. 2 and 3 for 1884. By Major H. W. L. Hime, R.A.
Miscellaneous Notes.
On the Means of Sparing Draught Animals.

EXPERIMENTS

WITH

A MILITARY PIGEON-POST,

MADE BY

CAPTAIN H. W. T. ALLATT, DUKE OF CORNWALL'S L.I.

COMMUNICATED BY

THE SECRETARY.

IN connection with the Easter operations of the Volunteers, 1885, experiments were made with messenger pigeons, the object being to show the value of these birds in warfare as a means of conveying messages long distances, when telegraphic and other means of communication have been cut off or interrupted.

For the purpose of the experiments, the invading forces near Brighton and Dover were supposed to be connected. The invaders having landed at Pegwell Bay, and being in possession of Deal and Walmer, have captured a loft of pigeons trained to fly to the latter place from any part of England. These birds having been sent by sea to Newhaven, have been landed with another Corps of the enemy advancing on Brighton, and by this means the enemy's forces are able to communicate with each other.

The English forces near Brighton communicated with their comrades at Dover under the following "General idea." The officer commanding at the latter station, learning that an enemy had landed on the South Coast, and was likely to interrupt telegraphic communication with Dover, sent some trained messenger pigeons by train to London. These birds accompanied the march of the British forces advancing against the enemy near Brighton, and their performances may be summarized as follows:—

On Sunday, 5th April, one bird flew from the British force at Brighton to the British at Dover, with the message:—"Enemy met with on the Downs, near Stanmer Park, and totally defeated."

Thus, notwithstanding the (supposed) failure of all other means of communication, over a distance of some 70 miles as the crow flies, the British forces at Dover were apprised of the momentous fact that the invaders had been totally defeated at Stanmer Park. This bird left

Brighton at 9.30 a.m., but did not reach Dover till 3.30 p.m., the slow velocity being due to its having been only partially trained, and to the hazy state of the atmosphere. It is, however, to be remembered, that trained birds, in favourable weather, can fly long distances at a velocity of over 50 miles an hour; for instance, in a pigeon race from Sandhurst to Brussels, which took place last September, and in which some 500 birds competed, the winner made a velocity of 1560 yards per minute, and 60 birds reached their lofts within one hour of the arrival of the winner.

On Monday, 6th April, three birds were tossed at different hours by the British force at or near Brighton for the British force at Dover, and one bird by the enemy near Brighton for the enemy near Walmer. They all performed their allotted tasks, reaching their destinations between 1.25 p.m. and 4.15 p.m. It is not stated at what times they were despatched; but it is probable that their velocity was indifferent, owing to thick and stormy weather. One of these birds had no message attached, the presumption being that it was too hastily liberated by an unpractised hand. Each of the other three was the bearer of news. One message, received by the Dover British force at 1.45 p.m., was:—"Brighton. British troops rapidly concentrating near Falmer; enemy about 7000 strong, in position on Newmarket Down." Thus, again, information of much importance was conveyed to the English commandant at Dover, and which, but for the messenger pigeon, he could not have received.

The enemy, however, were not idle; and, profiting by the capture of the English birds at Walmer, despatched from Brighton to their General at Walmer, and received by him, a pigeon conveying the following information:—"Expedition has pushed its advanced troops to Newmarket Hill. English concentrating from Brighton and London at Falmer, about 1,200 strong."

This is the first occasion on which pigeons have been used as messengers in connection with military operations in England; though in most continental countries a corps of trained birds forms part of the military establishment.

It is remarkable that in spite of the Franco-German War of 1870 having amply demonstrated the use of pigeons in warfare, no steps whatever have been taken in this country to organize a system of communication by this means, a means peculiarly suited to England, where coast defence and rapid and reliable communication between the several fortresses and other points is of paramount importance. It is obvious that facilities of inter-communication between forts or fortresses would be specially applicable to moving bodies of our troops, as, indeed, the experiments above described sufficiently prove.

It is the more to be regretted that a matter of such moment should continue to be overlooked, when it is remembered that each fort or garrison on the coast or in the interior could be supplied and maintained with an efficient number of pigeons at the cost of a mere bagatelle—a cost, in fact, which is far exceeded by that incurred by a single discharge of a big gun.

HOW FAR IS THE QUESTION OF MASSING GUNS IN THE FIELD AFFECTED BY MODERN IMPROVEMENTS?

BY

MAJOR A. W. WHITE, R.A.

DUM SPIRO SPERO.

The Silver Medal Prize Essay.

THE military arts change and develop, but the principles of war remain immutable. Introductory remarks.

It is recorded of Hannibal, at Cannæ, that he laughed as he surveyed the Roman order of attack; and we know that on the eve of Austerlitz Napoleon penned a bulletin that was all but prophetic. These, and similar examples without number, testify to the recognition which great Commanders in all ages have accorded to supreme laws—laws which have exhibited themselves in an endless variety of forms, according to the diversities of time and place, but have themselves continued unaltered, and are in fact unalterable.

To begin then, we have a rule of tactics, deduced from first principles, that it is essential to success in action to apply a preponderating force at the vital points of collision, and from this it follows that the most decisive application of any Arm within a given area, is that which produces a maximum effect in a minimum time.

The most decisive application of Artillery fire possible, is, therefore, that which produces its greatest concentration. But a concentration of Artillery fire is obviously a concentration of effective rounds; consequently the greatest concentration that can be carried out with regard to a given area, will be that which results in the greatest number of effective rounds within that area, in any given time.

Concentrations of Artillery fire.

In the field there are four cases which occur in relation to concentration of Artillery fire:—

1. Where it is practically impossible;
2. Where it can only be made by massing the guns;
3. Where it can only be made by dispersing them;
4. Where there is a choice in concentrating whether to mass or to disperse:

and the question we have to answer is virtually:—How far have modern appliances affected, and how are they likely to affect the relative frequency of these cases; and, finally, how do they tend to influence the choice of alternatives presented in the last case?

Modern Appliances enumerated.

For the purposes of this Essay, the expression "Modern Appliances" will be assumed to mean all recent military inventions and improvements, and therefore to include—

Alterations in Artillery matériel.

Range-finding.

Changes affecting Cavalry and Infantry.

Mitrailleuses.

Field Telegraphy and Signalling.

War Balloons.

Alterations in Artillery matériel.

The alterations in Artillery matériel which have followed the introduction of rifled ordnance, and especially those of the last few years, have, as we all know, caused an absolute revolution. It can no longer be pretended that Artillery is a mere auxiliary, producing a moral rather than a physical effect; it is now an independent Arm, the most versatile, so to speak, of all Arms; of all the most uniform in its action, as it is undoubtedly the most trustworthy in its results.

It would be tedious to enumerate changes where everything has been changed; but it may be useful to recount briefly what the field gun of European Armies is now, as compared with what it was less than thirty years ago.

Firstly, it is lighter and therefore more mobile, while the projectiles it fires are many times heavier and more destructive. Secondly, it delivers a fire more rapid and incomparably more accurate—the trajectories flatter, the range enormously increased. Thirdly, thanks to better shrapnel and improved fuzes, it is able to reproduce at long distances the man-killing effects of case at close quarters.

Of these changes, the most important, in a tactical point of view, is the great increase in the ranges at which an effective fire can be delivered. In the days of Wellington, 800 yards was thought a long range, now 1600 yards is considered a short one, and the tendency

of the day is still in the same direction.[1] The advances made towards obtaining a uniform and controllable gunpowder, the impending introduction of telescopic sighting, and the prospect of further improvements in guns, projectiles, and fuzes, all promise to extend more and more the radius of reliable shooting, and thus enlarge the area within which gunnery becomes a matter of mechanical certainty.[2]

Such is the existing state of things in respect to Artillery matériel; but if invention had stopped there, its full effects would never have been realized. To range-finding, the youngest of military arts, is due that what modern gun-building has rendered possible, modern gunnery is able to accomplish.

Range-finding.

Range-finding is a necessary consequence of high velocity guns. Whereas, formerly, it was easy to estimate the distance and correct the laying by a few trial shots, now it is often impossible to guess the range even approximately, and equally impossible to correct any erroneous estimate by observing from the Battery the results of the practice. Hence the need of some mode of measuring distances with scientific exactness, a want which has been met more or less satisfactorily by the telemeters, which all Services have adopted. In this country, the subject, for a time neglected, has made more real progress than abroad, but now that the days of trial shots are drawing to a close, the necessity of range-finding begins to be appreciated in every army of the world. The Watkin range-finder of the British Artillery, when in proper order and in proper hands, will measure distances up to 5000 yards with an error not exceeding the normal variation in the shooting of a field gun.

Much remains to be done; but this, at any rate, is a solid result actually attained.

Changes affecting Cavalry and Infantry.

In comparison with the development of Artillery during the present era, the change in the Cavalry Arm has been insignificant, while the Infantry on the other hand have undergone a complete transformation, due to the introduction of breech-loading rifles. The outcome of this is, that Infantry fire is now—

Possible up to 1,500 yards.

Irresistible up to about 400 yards.

The first of these facts is of much less consequence than the corresponding increase in the power of Artillery, because it can only be turned to account by the exercise of extraordinary individual skill, such as the constitution of modern armies does not tend to foster. With a gun, given the range, it is not difficult to burst a shell so as to take effect, but to hit with a rifle is quite another matter. It is besides much more difficult to find the ranges for Infantry than for Artillery,

[1] Guibert, writing in 1803, gives 1000 yards as the extreme range of Field Artillery; the "*Aide Memoire*" of 1853, in its range tables for field guns stops at 1400 yards.

[2] The high muzzle velocities of the new guns have brought about the striking anomaly that, within certain limits, the longer the range, the better is the practice.

because trial shots from rifles afford no information at all, and range-finders are hardly applicable where every man is working more or less independently. Thus it is doubtful if Infantry fire at distances over 600 yards will ever prove worth the great expenditure of ammunition and waste of energy involved.

On the other hand, perhaps the most important factor in modern tactics is the overwhelming nature of small-arm fire at very short ranges. This first became apparent in the campaign of 1866, which it may be said to have practically decided. The war in France which followed, furnished several examples on a large scale of this newly acquired power of Infantry; and the Russian repulse at Plevna, and our own combats in the Soudan have given us further and remarkable illustrations of the utter destruction which overtakes everything within the reach of rifle fire at close quarters. It must be admitted beyond dispute from this time forward, that neither Cavalry nor Artillery can venture any more within 500 yards of unbroken Infantry, while they will generally do well to keep at considerably greater distances.

Mitrailleuses.

There remains to be noticed a comparatively new but important Arm, which, if not a branch of Artillery, must be assigned an intermediate position between Artillery and Infantry. The mitrailleuse, or bullet machine gun, produces in its action the effect of an intensified rifle fire over a closely restricted area. Assisted by a range-finder its operation is as certain as a gun up to considerable distances, within which it is more than a match for a gun in the open. The tactical organization of bullet guns has hardly yet been settled, but their most effective employment would seem to be in rather large Batteries, and their function the attack and defence of bridges and defiles, the destruction of Cavalry and Infantry in close formations, and the occasional surprise of Artillery. It is quite conceivable that these guns may some day be assigned to Horse Artillery, or what will correspond to Horse Artillery, and they would certainly be very suitable as companions to Cavalry. Be this as it may, the development of this new Arm will undoubtedly have the effect of causing Artillery proper to prefer long ranges to short ones, and, whenever practicable, to take up positions where their action will not be interfered with, except by the Artillery on the other side.

Relative power of Artillery and other arms.

Summing up, then, the relative positions of the three, or shall we say *four* Arms, it appears that at distances from 1000 to 4000 yards and upwards the supremacy of Artillery is unquestionable. Cavalry, though indispensable, are of less importance than formerly in actual battle. Bullet machine guns are dangerous up to say 1000 yards, while Infantry are all powerful up to 400 yards.

Field Telegraphy and Signalling.

Passing on to modern appliances of a general kind, the most important is the new system of Field Telegraphy and Signalling, for by its means great armies will in future possess that homogeneity which formerly was only possible in small bodies.

It requires but a moment's consideration to appreciate the tremendous change impending. Whereas, until quite lately, a Commander was continually in the dark as to what was happening outside his im-

mediate neighbourhood, dependent for nearly everything on aides-de-camp and mounted orderlies; intelligence received many hours old; orders delivered many hours late; now he will be to all intents and purposes as effectually present with every Division of his Army as if he were with it in person, and consequently a thousand combinations will be possible, which in the old wars were entirely out of the question. In future campaigns every complete field force will have its regular system of telegraphic communication spread out like a network in every direction, with the field telegraphs as main lines, and the heliograph, flag, and other forms of signalling as tributaries. Things will not of course always work quite smoothly; but, speaking broadly, we may expect that distance will no longer be an impediment to unity of action in any military command however extended.

Balloons.

The adaptation of balloons to military purposes is another feature of modern war. We have not as yet had great experience of their value as a means of reconnaissance, but it is probable that they will ultimately be largely used for the purpose. Balloons are now under trial in the British Army, and appear to have been useful in the operations near Suakim. If reconnaissance from balloons becomes a general practice, the tactical result will be that concealment of motive will be rendered very difficult, and surprises on a large scale almost impossible. The notion of a General telegraphing his orders from a tethered balloon may seem slightly grotesque, nevertheless we may live to see some such arrangement universally adopted in extensive battles.

Effects of changes enumerated on the question of Artillery Concentrations.

Having thus completed our survey of the principal changes in the elements of warfare which modern appliances have brought about, we are in a position to return to the questions with which we set out, and endeavour to forecast how far these changes must modify the character and affect the frequency of the different cases relating to concentration of Artillery fire which we then enumerated.

1st Case.—Where concentration is impossible.

Instances of this will still often occur, and will in many campaigns be more the rule than the exception, notably when the country is flat and closely cultivated; still it must occasionally happen that the increased range of Artillery will enable advantage to be taken of commanding ground, which in old days would have been too far away to be available for occupation. It is worth noticing that the limit of a concentration is the circle which has for radius the extreme admissible range of the ordnance employed; and as the extreme effective range of a field gun now is about four times what it was thirty years ago, it follows that the ratio of the area within which a concentration may be made, is now sixteen times greater than it was then. We may conclude therefore that actions in which concentration of Artillery fire is impossible, will be less frequent in future than hitherto.

2nd Case.—Where concentration can only be made by massing the guns.

Almost the same remarks apply to this as to the former case. Since the area of country within which Artillery positions may be sought is now sixteen times as extensive as it used to be, we may reasonably expect that instances will occur where the massing of the guns would once have been unavoidable, but need no longer, as a matter of necessity, be resorted to.

And here it is as well to remark that apart from any predilection which Commanders in times past may have had for masses of guns in themselves, the limited ranges of those days absolutely necessitated this disposition whenever any great concentration was decided on. If, for instance, we take 800 yards as the longest reliable range of an old smooth-bore field gun, and the arc of a circle subtending 120 degrees to be the maximum convergence allowable, we shall find that this gives a front under 1700 yards, which would give room for about 90 guns drawn up in grand Battery at 19 yards interval; much closer packing being required if a nearer approach to the object of fire was desired. But in the days of Napoleon very short ranges were in fashion; for instance, at Champaubert, in 1814, the French guns were brought within 100 yards of the Russian squares; hence plainly the reason for not only massing guns at close intervals, but even for arranging them in tiers, when the slope of the ground permitted. At Waterloo, the grand concentration of the French guns on the British centre had to be made in front of the Infantry between the Charleroi road and Papelotte, and into this space of about 700 yards no less than 74 guns were crowded. Had the battle taken place in our days, Napoleon would have been able, if he wished it, to have placed these guns behind the Imperial Guard, some thousand yards or more back, and still to have directed a hot fire upon nearly any part of the British position.

3rd Case.—Where concentration can only be made by dispersion of guns.

This case in earlier times could only occur when the concentration of a few guns only was in question, for, from what has already been said, it is evident that no great concentration could ever take place at all unless the guns could be massed, and not only massed, but massed very closely. In future, however, there will certainly be occasions when massing cannot be resorted to, and yet concentration of fire may be possible. For example:—

1. The conformation of the ground may be unsuited to massing, and yet admit of concentrated fire from several points.

2. The concentration may be required too suddenly to admit of moving Batteries from the ground they occupy; or at any rate the operation of taking up new positions for a concentration of fire may involve much less loss of time than the movements required to mass. Or, again, the roads by which the Batteries would have to travel in the former case may be impassable, or exposed seriously to the enemy's fire. We may assume on the whole, therefore, that compulsory dispersion will occur more frequently in future than it has hitherto. The

magnitude of modern concentrations is of itself a reason for this supposition. At St. Privat, the Germans brought about three hundred guns to bear on the French position, a number which must of necessity have been subdivided into groups.

4th Case.—Where concentration can be made, with the guns either massed or dispersed.

Our examination of the three cases just discussed has established pretty clearly that,—

Concentration will be more often *possible* henceforward than formerly.

Massing, *as a necessity*, will occur less often.

Dispersion of guns with convergence of fire will be more often carried out as the only possible method of concentrating at all.

So far our way has been clear; but now we reach debatable ground. Will a concentration of fire only, or a concentration of guns with concentration of fire be preferred when circumstances admit of either expedient? Now there can be no doubt on which side the weight of authority leans. All Commanders who have turned Artillery to real account, have massed their guns, while those who have notoriously misused the Arm have dispersed them. Moreover, nearly every eminent writer on military subjects has maintained it as an infallible dogma that, for effective use, guns must be massed.

How then, it may be asked, can a different opinion be entertained. Certainly if the conditions of the problem were now as they were in days by no means remote, there would be little or nothing to say—the authority of Napoleon would alone decide the question. We know, however, that the conditions we have to deal with are not the same, are in fact totally different, and this may well justify some enquiry into the reasons on which the established theory rests. Fortunately we have not far to go, for we have them clearly enunciated by Sir Edward Hamley, as follows:—"Although it is true that Batteries posted widely apart can concentrate their fire, yet the importance of the point to be aimed at is not always apparent from every part, where separate Batteries may be posted; and separation is in itself a great hindrance to singleness of purpose and promptitude of action. It is found best, therefore, to concentrate the Batteries in masses." Now this was quite true of Artillery before the advent of range-finding and a perfected system of signalling—but is it true now? *Then*, Batteries, if posted widely apart, had to act independently, on general instructions promulgated hours beforehand, or upon orders issued during an action, but often arriving too late to be carried out completely, if not too late to be carried out at all. *Now*, a Battery may be isolated, as far as distance goes, but if the signalling is efficient, it need be separated by *minutes* only from the Officer in supreme command, allowing for all the intermediate links in the chain of authority; consequently when a

concentration is resolved on, it will be necessary simply to inform by signal the units concerned of the point of concentration, of their several changes of position (if there are to be changes of position) and of the exact moment for opening fire. Nor need Batteries or groups of Batteries have any difficulty in responding to such directions. Their range-finders will give them, in the course of ten minutes or so, two or three points to lay on within the prescribed area of concentration, and when the engagement has actually commenced, the interchange of signals from Battery to Battery will go far to ensure accurate practice; one Battery by this means acting as range party to another.

Here, then, we have surely no want of either singleness of purpose, or promptitude of action.

But there were other reasons for massing guns in the earlier wars. First of all, as we have already noticed, there was the restricted space combined with limited range. This has been obviated by the increased power of modern guns. Then there was the necessity for "trial shots." If the guns were side by side, or very near together, this caused little delay, but if the Batteries were posted far apart, the waste of time and ammunition was serious. Range-finding has disposed of this motive for massing. Lastly, there was the difficulty of communicating with dispersed Batteries, so as to ensure concerted action. Modern signalling has, we have seen, removed this objection.

Now let us turn to some of the arguments opposed to the practice of massing guns on a large scale, and in favour of the concerted action of dispersed Batteries or groups of Batteries, as being not only the most convenient formation but also that most conducive to the desired condition of *a maximum of effective rounds in a minimum time*.

1. In an Artillery duel massed guns must offer a very large target to the Artillery of their opponents, every round from which will probably take effect *somewhere*, if not exactly where aimed; whereas, if the massed guns concentrate on one of their several assailants, the target being small, many rounds must be thrown away with good range-finding even, so much so, that it becomes a mere arithmetical calculation to find out how soon a given number of massed guns must be exhausted in a struggle with an equal number of guns in Batteries at some distance apart.

2. The smoke from a large number of contiguous guns, would, in most cases, be a serious drawback, which a dispersion would obviate.

3. Guns once massed can hardly be used for a fresh combination in the same action.

4. Guns when massed can neither retreat nor advance as conveniently as when grouped in lesser numbers.

5. The preparations for massing are liable to be perceived by the enemy, especially if balloon reconnaissance is adopted; and if the object in view be detected, it will very probably be frustrated.

6. The operation of massing during the progress of an action is necessarily slow, and deprives the side which adopts the manœuvre of a large proportion of its Artillery while it is on the march.

7. Massed guns will greatly invite the enterprises of mitrailleuses, which would hardly be diverted from their legitimate employment for the attack of any small number of guns, if protected by the cross-fire of other Batteries too far off to be assailed.

8. Occasions might even arise when massed guns, if unprotected by other Arms, might be exposed to the attack of Cavalry.[1]

The above, if by no means an exhaustive review of the question, is at least sufficient to show that there are many valid reasons against massing guns when their fire can be concentrated without doing so; and that there is very much to be said in favour of posting Artillery in small groups so that they may take full advantage of the ground, be able to act independently, and manœuvre boldly if necessary, and still be capable, when called upon, to direct a converging fire on any point indicated; the indispensable conditions being good range-finding, and efficient signalling. The whole question is really part of a more comprehensive subject on which opinions at the present time greatly differ, viz.,—What is the proper *rôle* of Field Artillery?

Formerly it was commonly held that Artillery must always conform to the movements of other Arms, in the sense of following them from point to point, and that the only alternative was to gather the Batteries together from far and near, and so lump them securely, where, if not very useful, they might be at any rate not altogether out of hand. This theory is of course exploded now-a-days, but is there no trace of it to be found in the plea often put forward for massed guns and short ranges, that this disposition encourages the other Arms and enables the guns to protect themselves? Surely this view, though favoured in Germany,[2] is wrong.

If Artillery, in place of endeavouring to engage at short range, were to take up commanding positions as early as possible in an engagement—positions from which every part of the field could be seen, it would be not only better able to join in large concentrations when required, but would be capable of rendering quite as efficient a support to the other Arms with which it was associated, as if it attempted to nurse them closely—advancing or retiring, with exposure and embarrassment, over ground which its fire could perfectly well cover, without any change of position at all. If we remember that the range of a field gun is now over 4,000 yards, it becomes evident that its best place is, as a rule, about 2,000 yards in rear of the line of Infantry combat. From there it can operate over nearly a mile of ground either way, towards itself or towards the enemy, and is therefore in the most advantageous position to support either an advance or a

[1] See Hamley, "Operations of War"; p. 434.

[2] See for example, Boguslawski—"Tactical Deductions from the War of 1870–71."

retreat, to join in a turning movement, or to form a concentration to centre or flank. Unfortunately the tendency of parade ground exercises is rather to encourage the idea that Artillery must, above all things, keep itself "*en evidence*," and that the function of Batteries is to be continually on the move; until this notion has been completely got rid of, there will be little chance, in action, of avoiding the vicious alternative of either dispersing the Artillery, without definite aim or capability of union, or else of imprisoning it in an immovable mass in which half of its tactical value will be lost, and its action fatally hampered.

Concluding remarks.

It is unfortunate that the records of recent warfare throw so little light on the question of massing.

The Franco-German war took place before signalling had attained the perfection it has now arrived at, and when range-finding was practically unknown. The German Artillery was superior to the French, and was uniformly successful, but it would be a mistake to suppose that the tactics followed were invariably sound. As a rule, the Germans massed their guns at rather short ranges, and overpowered the French Artillery, not on this account, but because the latter rarely attempted to concentrate at all. Thus, at Woerth, the Germans had 120 guns in Grand Battery on the heights, opposite to, and some 2,000 yards from the French centre (the only position there was for them), while the French brought their Artillery into action in a desultory way here and there, and attempted nothing definite. At Gravelotte and Sedan it was just the same, the Germans concentrated by massing as much as possible, and the French adopted a dispersion without concentration, and apparently without object.

We have therefore yet to ascertain experimentally whether by the judicious use of modern appliances, an Artillery can, while still adhering to its proper unit, *the Battery*, yet so work, as a whole, that great concentrations can be carried out successfully with groups posted far apart, and communicating with one another and with Head Quarters by signal. Everything clearly points to this consummation. We cannot invoke to our aid, it is true, the direct testimony of Military History, but its indirect lessons ought to be sufficient.

We should, at all events, look into this subject carefully, and above all things beware of clinging blindly to a favorite tradition, however associated it may be with honourable names and ever memorable triumphs. A great war may at any time subject our theories to a crucial test.

Let us devoutly hope that when the day of trial has come and gone, we may not, by any mischance, find ourselves driven to say with King Richard III :—

"Look what is done cannot be now amended,
"Men shall deal unadvisedly sometimes,
"Which after hours give leisure to repent."

PRÉCIS

AND

TRANSLATIONS.

FRANCE.

I.

REVUE DE CAVALERIE,

APRIL, 1885.

BY

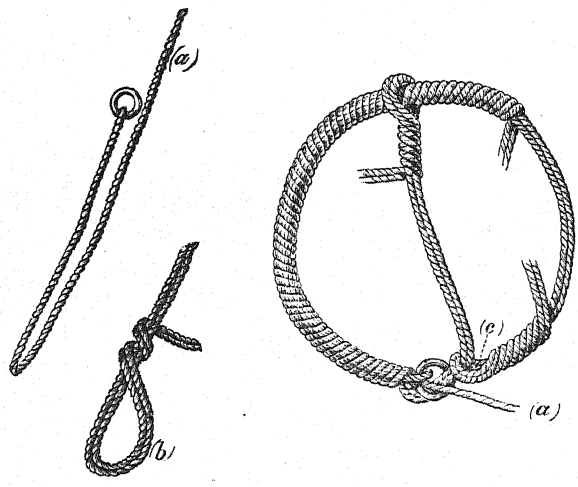
LIEUT. ST. J. L. H. DU PLAT-TAYLOR, R.A.

ON the recommendation of the Committee of Enquiry of Cavalry, the Minister of War orders that from this date a tethering ring (of Italian pattern) made of a foraging rope (lasso ?) shall be exclusively used for tethering horses in bivouac in Regiments at home. Hobbling and picketing is to be discontinued.

The following instructions are issued, and are to be adhered to in using and making the rings:—

Fold the rope in two so that the end without the iron ring (*a*) projects about 8 inches beyond the other end. Hold the doubled rope about 18 inches from the ring and commence seizing it with the loose bight, working towards the iron ring, and keeping the work tight and close, leaving a small loop where the seizing commences (*b*). When the seizing reaches the iron ring, pass the bight through it, then through the loop (*c*), thus forming a complete ring of rope; pass the bight round the opposite side of ring of rope, and seize this cross piece, working

towards the iron ring again, when this is reached the bight is fastened by passing the loose end (*a*) through it and knotting it. This roll is fastened to the off shoe pocket. About 12 fully equipped, or 16 unsaddled, horses can be tied to it.



The horses from line are wheeled inwards on the centre, and the head ropes tied to the ring: one man can attend to this number.

NOTES:

BY VARIOUS HANDS.

Prize Essay.

The following is the subject for the Prize Essay of 1886:—

"The General Arrangement and Practical Working of the Artillery Defence of a first class Coast Fortress, protecting a Harbour and Dockyard."

The candidates must be Officers of the Regiment who are Members of the R. A. Institution.

The Essays, *which must not exceed 16 printed pages of the "Proceedings,"* must be forwarded to the Secretary so as to reach him on or before the 1st of April next. The Essays to be strictly anonymous, but each to have a motto, and be accompanied by a sealed envelope with the motto written on the outside, and the name of the candidate inside.

The Essays will be submitted for decision to three Judges, chosen by the Committee.

The Judges are empowered to recommend:—

1. That two Medals, one Gold and one Silver, be awarded; or,
2. That only one Medal, Gold or Silver according to the merit of the Essay, be awarded; or,
3. That no Medal be awarded.

The names of the successful candidates will be announced at the Annual Meeting, and medallists will be distinguished as such in all lists, &c., issued from the Institution; and in the event of a University man gaining a Medal, a report of his success will be made to the University of which he may be a Member.

The successful Essays will be printed and circulated to members by the Institution.—*H.W.L.H.*

In continuation of the description of the Hobbling Apparatus, invented by Captain H. T. W. Allatt, Duke of Cornwall's L.I., given in "Proceedings," Vol. XIII., p. 364, the following reports are published.—*H.W.L.H.*

Captain Jones, Riding Master, Canterbury Cavalry Depôt, reports on 21st October, 1884:—

"I have tried your Hobbling Apparatus on several horses, and find it answers very well. There is no difficulty in training horses to its use. I think it much better than knee haltering."

Colonel Richards, Professor of Military Topography and Reconnaissance at the Staff College, reports on 9th July, 1884:—

"I consider Captain Allatt's Patent Apparatus for Hobbling Horses to be a *sine-qua-non* to Officers employed in reconnaissance, especially on service. Any person who, in the performance of such duty, has experienced the difficulty of securing his horse for a time in open ground, and the anxiety as to whether he will be able to catch him again, mount, and gallop away if hard pressed, will gladly avail himself of this capital contrivance."

Lieut.-Colonel Bowdler Bell, late 8th Hussars, D.-A.-Q.-M.-G. at Head Quarters, writes on 14th November, 1884:—

"I have personally tried Captain Allatt's system of Hobbling Horses, and find it answers admirably for reconnaissance work. After a few days experience, any horse would, in my opinion, become reconciled to the shackles; and, having ridden long distances on heavy roads and over all sorts of ground with them on, I am satisfied that the action of a horse is not impeded by them, and I do not think it possible that a horse could be injured by constantly wearing them."

Lieut.-Colonel Bond, R.E., Commanding Pontoon Troop, Aldershot, writes on 6th November, 1884:—

"I have much pleasure in reporting on your Hobbling Apparatus, which I have now had for a considerable time on trial. It is certainly a capital means of securing a horse in the open, and I think would meet many requirements of the service, if introduced as an article of store. It is just the thing I should have liked in India, either for shooting or survey work. It would be useful to an Officer, R.E., while looking after working parties, &c., as it would not be necessary to call a man away from his work for the purpose of holding the Officer's horse when he dismounted."

Captain Beaufort, Royal Artillery, writes on 20th October, 1884, from the Staff College:—

"Your Hobbling Apparatus has been *most* useful. I have used it on every reconnaissance on horseback. When I wished to leave the high road for some reason, such as to examine buildings, &c., to which I could not take the horse, I have simply hobbled him and left him grazing at the side of the road. The arrangement is simple, and easily worked, and a horse soon gets accustomed to it; so much is the latter the case, that once or twice I have not hesitated to ride my pony to the Cricket Ground, hobble him and let him graze, while I have played for an hour or more at the net. I strongly recommend all Staff Officers on service to provide themselves with one."

Captain Hodgins, Riding-Master, Royal Military College, Sandhurst, writes on 15th August, 1884 :—

"I am very pleased to give you my opinion of your Apparatus. I have tried it, and I think it the most simple way of hobbling horses that I have ever seen."

Allatt's Patent Hobbling Apparatus can be had of the following Agents. Price, 12s. 6d. the set complete. By Parcels Post 6d. extra :—

Aldershot.—W. Stone, Saddler, &c., 9, Wellington Street, Aldershot.
Camberley.—G. J. Evans, Saddler, &c., Camberley, Surrey.
Dover.—Thos. Bannon, Saddler, &c., 13, Cannon Street, Dover.
Farnborough.—G. J. Evans, Saddler, &c., Farnborough Station, Hants.
Folkestone.—Thos. Bannon, Saddler, &c., 32, Rendezvous Street, Folkestone.
London.—Frederick Lee, Saddler, &c., 65, Long Acre, London, W.C.
Sandhurst.—G. J. Evans, Saddler, &c., Sandhurst, Berks.
Woolwich.—W. W. White, Saddler, &c., 18, Artillery Place, and Royal Artillery Agency, 5, Frances Street, Woolwich.

William Cobbett and Magnum Bonum.

The following inscription taken from Cobbett's tombstone in Farnham Church Yard, finally settles the question raised some time ago as to the Arm in which he served :—

WILLIAM COBBETT,

BORN IN THE PARISH OF FARNHAM, 9TH MARCH, 1762.

ENLISTED INTO 54TH REGIMENT OF FOOT IN 1784, OF WHICH REGIMENT HE BECAME SERGEANT-MAJOR IN 1785, AND OBTAINED HIS DISCHARGE IN 1791.

IN 1832 HE WAS RETURNED TO PARLIAMENT FOR THE BOROUGH OF OLDHAM, AND DIED 18TH JUNE, 1835.

The well-known Magnum Bonum was for a time a Private in the same Regiment as Cobbett, but after him.

Magnum first began to make a little money by frequenting the wharves in Quebec, when his Regiment was stationed there, and exchanging for the emigrants, coming on shore, their sterling money for currency for a small percentage.

This information I had from Magnum himself; and anyone who has ever seen the helplessness of Irish emigrants landing at Quebec, will understand the likelihood of his usefulness.

Magnum's career in Woolwich began, I think, about 1850, by his selling magnum bonum pens about the Barracks. His real name was Isaacson.—*J.M.S.F.*

Regimental Colours.

The following table shows the result of the voting upon the question of the Regimental Colours:—

Command.	No. of Officers in Command.	I.	II.	III.	IV.	V.	VI.	Old Colours.	Total.	Remarks.
Woolwich	76	6	1	1	—	2	3	48*	61	* 18 for darker blue.
Aldershot	49	—	3	1	2	7	22	13	48	
Portsmouth ...	70	*nil.*	1	6	—	—	24	30*	61	* 23 for darker blue.
Plymouth	27	3	7	—	2	—	3	2	17	
Dublin	18	1	—	—	—	2	1	11	15	
Newbridge ...	13	—	—	—	—	—	—	12*	12	* 12 darker blue.
Queenstown ...	14	—	—	—	—	—	7	2*	9	* 2 with darker blue.
Cork	24	—	5	—	2	1	6	10*	24	* 7 darker blue.
Sheerness	25	1	3	—	—	—	7	2	13	
Shoeburyness	50	—	32	—	—	—	—	6	38	
Meerut	21	—	—	—	—	1	—	20	21	
Malta	29	—	—	7	1	1	1	19	29	
Kirkee	20	—	—	2	—	2	—	16	20	
Gibraltar	22	—	—	—	—	4	—	18	22	
Totals ...	458	11	52	17	7	20	74	219	390	

Votes are as follows:—No. I., 11; No. II., 52; No. III., 17; No. IV., 7; No. V., 20; No. VI., 74; old colours, 219, of which 62 vote for darker blue.

In consequence of the result of the voting, the old colours will be adhered to.—*A.E.R.*

At a meeting of the Committee held on 15 June, 1885, it was resolved to discontinue the sale of the "Handbook for Field Service" at the reduced rate of 2s. 6d. The price will, therefore, in future be 3s. 6d.
—*H.W.L.H.*

Books must be returned within one month of date of issue. Per Regd. Post.

Date of issue.	Return.	Date of issue.	Return.